HERPETOLOGICA

Established 1936. Organ of the HERPETOLOGISTS' LEAGUE,
A.A.A.S. Associate. Society of Systematic Zoology, Affiliate.

President, Dr. Hobart M. Smith. Vice-President, Dr. Angus M. Woodbury.
Secretary-Treasurer and Publisher, Chapman Grant,
Route 1, Box 80, Escondido, California.

Edited by the Officers. Policies determined by the Members. $4.00 per volume

Vol. 12 May 28, 1956 Part 2

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The Geographical Distribution and Constancy of the *semifasciata* Pattern in the Eastern Garter Snake

By PHILIP W. SMITH

The extreme variability in color and pattern of the wide-ranging Eastern garter snake, *Thamnophis sirtalis sirtalis* (Linnaeus), is reflected by the existence of 10 junior synonyms for this one subspecies as listed in the most recent check list (Schmidt, 1953, check list N. Amer. Amphs., Repts.: 174). The variation in color and pattern is often individual rather than geographic. In some cases, however, local races with definable geographic ranges are apparent, although none of the variant populations is currently accorded nomenclatural recognition. One of the infrasubspecies with a definable range is discussed in this paper.

Cope (1892, Proc. U. S. Nat. Mus., 14: 622), described *Eutaenia sirtalis semifasciata* from Des Plaines, Cook County, Illinois, and from Wisconsin, chiefly on the basis of the tendency for the anterior portion of the lateral stripe to be interrupted at intervals by crossbars formed by the fusion of the black spots just above and just below the lateral stripe fig. 1). Ruthven (1908, Bull. U. S. Nat. Mus., 61:176) relegated *semifasciata* and four other varietal names to the synonymy of *sirtalis*. Regarding *semifasciata*, he wrote (*op. cit.*: 184):

> "This coloration occurs very frequently in and immediately about the 'prairie peninsula' in Indiana, Illinois, southern Michigan, and southern Wisconsin, and apparently much less frequently to the east and south of this region. But not all of the specimens from this region exhibit this tendency . . . Many individuals are found which either have but one or two or even no blotches, and it is evident that the character is far from being a constant one. It is significant that the region where this color phase is best developed is close to the range of *parietalis*, which often exhibits the same phenomenon."

Since Ruthven's monograph, it has apparently been assumed by students of snakes that the *semifasciata* pattern type is merely one of many possible expressions of normal individual variation in *Thamnophis s. sirtalis* and accordingly may occur anywhere within the geographic range of the subspecies. In the early stages of our survey of the Illinois herpetofauna, the frequency of this pattern was noted to increase sharply toward the northeast so that the provenance of specimens could be guessed with some accuracy by noting the development of the lateral crossbars.

Recently through the courtesy of Hobart M. Smith, Robert F. Inger, and Hymen Marx, data for specimens deposited in the University of Illinois Natural History Museum and the Chicago Natural History Museum have been added to those from our Survey collection. Most of these 440 snakes are from the critical states of Wisconsin, Illinois, Indiana, and Michigan. A few specimens were also examined from scattered localities in other parts of the range. The results of this study are shown in figure 2. The innermost of the three concentric lines or isophenes encloses all localities from which the *semifasciata* type of pattern comprises 90% or more of the snakes in the samples. The middle isophene connects localities in which the *semifasciata* pattern comprises 50% of the snakes available. The outer isophene connects localities of approximately 20% *semifasciata* frequency. The number enclosed by each concentric line is the number of snakes examined in that geographic area.

As Ruthven (*loc. cit.*) pointed out, the *semifasciata* type occurs most commonly in the area where Wisconsin, Illinois, Indiana, and Michigan approach each other and occurs less frequently to the south and east. It is apparent in figure 2 that the frequency of this character also diminishes to the north and to the west, likewise in clinal fashion. The cline is quite steep to the east and to the west of the Chicago area, somewhat less steep to the north and to the south. The geographic center of *semifasciata* is northern Cook County, Illinois, and it borders Lake Michigan which is apparently an effective barrier preventing a dispersion of the crossbarred pattern in a northeasterly direction.

In contrast to Ruthven's conclusions, however, the more adequate sample now available reveals that the crossbarred pattern is relatively constant in the Chicago region. Of the 162 specimens studied from northeastern Illinois and adjacent Wisconsin and Indiana, over 90% have the lateral stripe interrupted by two or more crossbars on each side of the body, regardless of size or sex. The *semifasciata* pattern has been noted on infrequent specimens as far from Chicago as extreme southern Indiana (Dr. Sherman A. Minton, personal communication) and southern Illinois, where, however, it is extremely rare.

Ruthven's remark that some significance can be attached to the proximity of *semifasciata* and the range of *T. s. parietalis* deserves comment. Although *parietalis* is not far removed geographically, the *semifasciata* pattern cannot be considered as an expression of a *sirtalis* X *parietalis* intergrade population. The area of intergradation between these two subspecies is vague, but it lies somewhere west of the Mississippi River. There is no step in the clines for ventral and caudal scale counts or in the frequency of snakes with red groundcolor to suggest a genetic influence of *parietalis* within Illinois. The *semifasciata*

population is completely surrounded by the nominate race *T. s. sirtalis.*

The occurrence of the crossbarred condition in *parietalis* needs confirmation. Specimens of *parietalis* and even some *sirtalis* (with the dark spots fused and in a checkerboard arrangement between the longitudinal light stripes, thus resembling *parietalis)* tend to lose the lateral stripes in preservative, particularly in formalin. The lateral light stripes in these snakes are superimposed on the dark markings, and the crossbars appear only when the lateral stripes have faded out in preservative. In my experience the lateral stripes of these snakes are seldom, if ever, interrupted by dark crossbars on living or freshly preserved specimens.

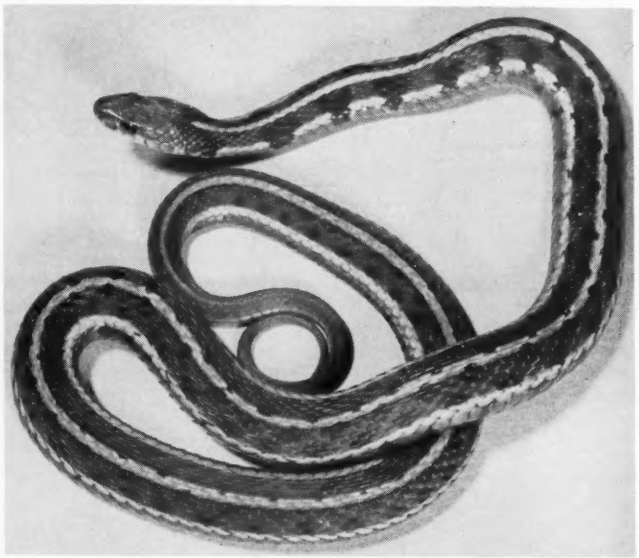

Fig. 1. Adult Eastern garter snake from Lake Villa, Lake County, Illinois. Photo by Wm. E. Clark.

Apparently *"semifasciata"* is recognizable only by the pattern features already described and illustrated in figure 1. The mean ventral and caudal scale counts for a sample of 40 *"semifasciata"* and a similar-sized sample of snakes from southern Illinois are almost identical. Accordingly, whether or not this population is distinctive enough to be given nomenclatural recognition is largely a matter of personal preference. If the name *semifasciata* is resurrected for this snake and its range defined, the greatest diameter of the range in which 70% (the customary split in snake subspecies) are assignable is only 160 miles. Moreover, the *"semifasciata"* range lies completely within the range of another subspecies, *Thamnophis s. sirtalis.* Nevertheless, although this situation is rather unusual, *"semifasciata"* does satisfy the requirements for sub-

specific recognition under present subspecies concepts, and there is a precedent for naming small populations that are partially or completely encircled by another subspecies. A similar situation involving distinct but localized populations of terrestrial vertebrates is well known in the San Francisco Bay region of California and in the White Sands of New Mexico.

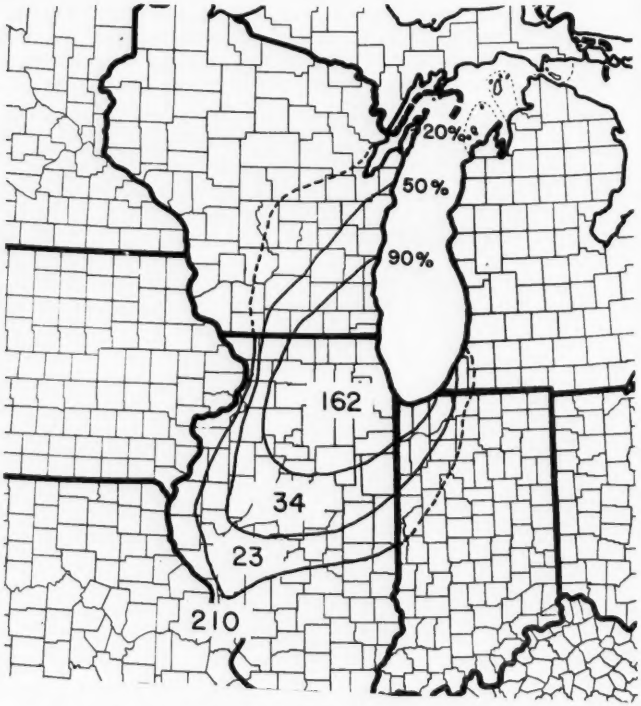

Fig. 2. Geographical distribution of frequencies of the *semifasciata* pattern. Solid lines connect localities from which frequencies are approximately equal; broken lines indicate uncertainty.

The objective of this paper, however, is merely to call attention to the constancy and geographical distribution of the *"semifasciata"* pattern. If this population should prove to be of zoogeographic significance, it will be of interest to scrutinize the western border of Lake Michigan for distributional and variational peculiarities in other animals. With this thought in mind, it might be pointed out that the center of the range of *"semifasciata"* is very close to the small relict colony of *Thamnophis butleri* which borders Lake Michigan in extreme southeastern Wisconsin.

ILLINOIS NATURAL HISTORY SURVEY, URBANA.

Report on a Collection of Hispaniolan Reptiles

By CHAPMAN GRANT

During a few days in 1946 the opportunity was taken to collect reptiles insofar as possible with little or no equipment in the environs of Ciudad Trujillo, Santo Domingo. Headquarters were established at La Romana Sugar Co. In addition to the series acquired by the author in the indicated area, other specimens from the vicinity of Port-au-Prince, Haiti, have been provided through the courtesy of Mr. Anthony Curtiss, and are here reported in conjunction with the Santo Domingo collection. The specimens are now in the Stanford University collection.

References throughout the following pages to "Cochran" pertain to her Herpetology of Hispaniola (1941, Bull. U. S. Nat. Mus., 177).

Pseudemys decorata Barbour and Carr. A young specimen with typical pattern was found in the fish pond of Trujillo City.

Gonatodes notatus (Reinhardt and Lütken). A series of 15, including five adult males, 5 adult females and 5 young of which 3 appear to be newly-hatched (being less than 2 cm. s-v.), agree with Cochran's series of 7. The young bear a pattern like the patterned females. This pattern either disappears with maturity of the females, or those not showing it may have been preserved when the pattern was obscured. The males possess large escutcheons with modified scales extending well onto the thighs. I believe this form is identified with *G. fuscus* of Jamaica. Mr. Curtiss, who collected these specimens, gives the following notes: "Male brownish with head orange, and a sky-blue, black-bordered mark on shoulder; female pale brown with dark markings. Male changes color quickly in preservative. Found in houses in Port-au-Prince; on large trees in the Cul-de-sac Plain; common."

Hemidactylus brooki Gray. Like the population on Puerto Rico, this gecko squeaks when grabbed by hand. I have never heard it squeak unprovoked. Nine specimens were taken in buildings in Trujillo City, 12 at La Romana.

One specimen was saffron all over dorsum, one uniformly brown without pattern; in the series as a whole the pattern is not as apparent, either on body or tail, as in specimens from Puerto Rico. Several specimens had a soft "limey"-appearing secretion under the skin of the head. The tails seem stronger than in specimens of the Puerto Rico area; fewer tails were regenerated, and specimens wrapped their tails around one's fingers and bit without breaking the tail. The fifth toe, not the thumb, is opposed. Old males have larger tubercles and much longer tail spines. The common name is "salamanqueja."

Aristelliger expectatus Cochran. Cochran had four specimens of this species to examine. The one adult, one half-grown and three young collected by Mr. Curtiss fully bear out her findings. The pattern on the small ones is of course clearer than on adults and two small specimens, 2 cm. s-v, exhibit a white-ringed tail, a character common to many geckos.

The dorsal rectangles grow lighter and become rings as they pass onto the tail so that the distal half thereof bears 3 or 4 alternate black and white segments, the black ones being about twice as long as the white. The tail is slightly longer than s-v.

Mr. Curtiss writes: "Common on large trees on the Cul-de-sac Plain and in Port-au-Prince. There is a small colony in a tree in our yard. The Creole name is "agaman" the final "an" nasal, as in French.

Sphaerodactylus cinereus Wagler. Forty-five specimens were taken on the Cul-de-sac Plain near Port-au-Prince by Mr. Curtiss. Mittleman discusses this series at length in Herpetologica 6 (3): 60-66, 1950, with a plate showing pattern change with growth. The same plate appeared two years previously (Journ. Ent. Zool., 40 (4): 69-71).

Sphaerodactylus stejnegeri Cochran. Mr. Curtiss sent me 33 specimens taken September 18, 1948, at Hatte Lathan, near Damiens, Haiti. The sexual dichromatism of this species has already been described and illustrated (Copeia, 1949: 74-75). The females are banded, the males unicolor. Mr. Curtiss states that the Haitian name for Sphaerodactyls is "Zandolide" or "Zandolique" and that the lizard is sacred to the "goddess" "Erzulie" or "Erzilie."

Sphaerodactylus difficilis Barbour. Seven adults and 7 juveniles were taken at La Romana. This gecko shows a growth-pattern change similar to that of *S. cinereus*. The escutcheon of the male is very much reduced in size and without extensions onto the thighs. The color of the adult is a light tan background with large brown spots on the upper surfaces; the sub-adults retain the stripes across the tail, whereas the young are cross-striped except on head and neck. My series is not large enough to determine whether the nuchal "mask" disappears with age, is individual or sexual.

Sphaerodactylus armstrongi Noble and Hassler. Six specimens were collected by Mr. Curtiss in Port-au-Prince. All bear the "mask" pattern on shoulders and are very reminiscent of *S. macrolepis* of the Puerto Rico region.

Anolis distichus dominicensis Reinhardt and Lütken. Numerous specimens were seen in Trujillo City and at La Romana. About a dozen were preserved. The females are gray, the males with a small, orange-red fan with yellow edge and gray scales, starting opposite ear and ending half way between levels of shoulder and adpressed elbow; anals poorly developed; tail crest large; a depression just posterior to vent in male; female with a groove posterior to vent; fan very small and not colored. Frequently seen with a very rich, velvety-appearing deep chocolate coloration.

Anolis chlorocyanus Dumeril and Bibron. Many specimens were observed in Trujillo City and La Romana. Several were preserved. Fan small, starting half way between levels of shoulder and adpressed elbow; all upper surfaces brilliant grass green, lighter underneath, posterior part of fan-skin black, covered with coarse white scales, anterior part bluish,

covered with fine green scales; slight nuchal fold; females with a white dorsal stripe.

Anolis cybotes cybotes Cope. This species, taken at both Trujillo City and La Romana, is represented by a number of color variants, some described in the following. Adult male: dull light tan; dewlap duller, lighter tan with several sooty stripes from throat; hyoid to midventer; fan to 1/3 distance between shoulders and vent; 2 enlarged postanals; 12 lamellae on enlargement of longest toe. Another adult male: 2 faint greenish lateral stripes bordered by reddish brown; similarly colored maculations on back and sides; dorsal and nuchal crest present; "spectacle" pattern on sacrum; fingers and toes black; fan large, gray with sooty stripes and coarse scales in 3 concentric bands; belly opalescent; tail with 10 or more dark vertical bars bordered posteriorly with light. Another very large male, "bull-headed" in life: many cross bars on body and tail; 2 light greenish stripes on each side bordered by reddish brown; fan almost white; sooty under jaws; 3 rows of close-set scales on fan; 68 mm. s-v. Males from La Romana: very distinct nucho-dorsal fold; fan olive-green anteriorly, olive-yellow posteriorly; frequently a prominent, light stripe from eye to eye; a transverse pattern or plain with prominent dorsolateral stripes.

This species takes on a variety of patterns, but some examples were kept alive several days and marked. It was found that those with dorsolateral stripes did not assume the equally common spot-and-triangle pattern.

Leiocephalus personatus lunatus Cochran. In a series from Trujillo City the flanks have occasional bright turquoise and fewer brick-red scales scattered among the brown; only one pair of parietals on each side of occipital; no large latero-nuchal.

Celestus costatus (Cope). Two specimens collected by Mr. Curtiss at L'eau Gaille, Dec. 1, 1949. These specimens represent the *C. occiduus* group of longlegged forms of Jamaica, in which the foreleg, measured shoulder to tip of claws, is greater than the distance from snout to ear. This measurement was adopted during field study in Jamaica where it was noted that members of the long-arm group run to escape, whereas those of the short-arm, *crusculus* group wriggle. There are other features dividing the two groups. The measurement snout-to ear was adopted as it has a definite place to begin and end the measurement.

Notes supplied by Mr. Curtiss state that "an unusually swollen female taken at L'eau Gaille in February, 1943, gave birth to seven young two months later."

Ameiva chrysolaema chrysolaema Cope. A young male from Trujillo City has an unusual coloration not corresponding with that given by Cochran.

Members of the genus *Ameiva* are called "ranas," the Spanish name for frogs. Curiously, the marine toad (*Bufo marinus* Linnaeus), which is common at both Trujillo City and La Romana, is called "maco."

Ameiva taenura Cope. A young example from La Romana has the tail bright blue becoming peacock green at base; distinct white line below lateral stripe; snout, chin and throat orange.

Typhlops lumbricalis (Linnaeus). Four specimens were collected by Mr. Curtiss, three at L'eau Gaille Oct. 25, 1949, and one from Port-au-Prince, Nov. 16, 1949. Respectively the scales around body anteriorly are 20, 20, 20, 20, posteriorly 18, 19, 18, 18; scales mental to vent, 266, 260, 257, 270; scales rostral to tail spine, 257, 269, 275, 263; subcaudals, 15, 15, 14, 14; total length in mm., 230, 213, 205, 115; tail length in mm. 9, 9, 6, 4. Color brown above, cream below, the colors blending in an irregular line.

Uromacer catesbyi (Schlegel). One specimen from La Romana is a female with 170 ventrals, divided anal, 172 caudals, head and body 695 mm., tail 500 mm.

Dromicus parvifrons niger Dunn. Two specimens, both females, are from La Romana; one contained seven eggs. The ventrals are 152 and 154, caudals 122 and 87 respectively. The second specimen appears to have a perfect tail with a terminal "spine," showing that regeneration can be apparently perfect without actually replacing lost caudals.

Color in one black above, anterior half of body with the first three rows gray-green, 4th black, broken pattern of light spots on rows 5-6; belly, chin and upper labials yellow; posterior half of body black; edge of divided anal and under tail lip lighter.

In the second specimen, a much blacker snake, chin and neck flesh-colored with scattered black spots; belly blotched, gradually darkening to black on posterior half; divided anal light-edged; posterior third of ventral surface of tail orange-yellow.

The scale pits are of special interest. Schmidt (1928, Amph. Rept. Porto Rico: 135) describing *D. stahli* states "scales smooth, without pores . . ." and in notes under *D. exiguus* (op. cit.: 138), ". . . smooth scales without pores . . ." Stejneger (1902, Rep. U. S. Nat. Mus.: 695) observes that on *Leimadophis* (*Dromicus*) he ". . . occasionally found a single, more or less obscure, pore . . ." Cochran (1941: 355-369) states specifically for all 7 subspecies of *Leimadophis* (=*Dromicus*) *parvifrons*, "scales without pores." According to my own observations, the first snake has anteriorly a very few scattered single apical pits; last fifth of dorsum with many single pits; tail nearly to tip with single pits on 4 dorsal rows; where "double scales" appear at reduction of rows, double pits are seen. In the second specimen, on the anterior fifth of the upper surface almost every scale has a single terminal pit, and a very few scales have double pits; most scales on the tail bear double pits.

From the above it would appear that describers heretofore have examined only the dorsum at about midbody, whereas the pits appear primarily at neck and sacral regions.

In a letter dated Dec. 1, 1950, Dr. Cochran stated: "I have just re-examined our paratypes, and find that on the tail there is an occasional scale with 1 pore opposite the anus, and opposite the 54th subcaudal there are wider scales which occasionally bear 2 pores. In paratypes of *rosamondae, armouri, alleni* and *lincolni*, as well as *tortuganus*, I find 1 pore beginning opposite 11th, 8th, 15th, 10th and 20th subcaudals respectively, with 2 pores on the posterior supracaudals in all but *alleni*. None of

the *niger* which I just examined—about 5 paratypes—had any pore or pores on the body, but all had some on the tail."

The snakes of this genus provide material of considerable interest in zoogeographical speculation. The subject of the removal of natural barriers with the consequent intermingling of populations is of much interest and one to be approached with caution. I have attempted to prove (1941, Bull. Inst. Jamaica Sci. Ser., 1: 61-148) that the speciation of the herpetofauna of Portland Point, Jamaica, occurred while this was an island and that the present low connection with Jamaica proper, although of long standing, has not admitted intergrading of upland forms. Elsewhere I brought forward arguments (Copeia, 1935: 186-188) to disprove that the building of bridges across rivers would remove the barriers to the movements of box turtles and that these rivers had never constituted barriers.

Cochran considers that the joining of the island of Samana to northeastern Santo Domingo has removed a barrier to the spread of the black form of *Dromicus* (*Leimadophis*); she says (1941: 2) "An example of the effect of the removal of a natural barrier is evident here. Almost within the memory of the oldest inhabitant, Samana Peninsula was an island separated from the main body of Hispaniola by a rapidly filling strait . . . On this island a black form of *Leimadophis* developed . . . it is at present very difficult to find a satisfactory basis for the separation of *niger* [the black specimens] and *protenus* [lighter colored specimens] as subspecies, since so many intergrading specimens now exist in the lowlands lying between the areas once separated by *stretches of sea.*" (Italics mine).

While en route to Santo Domingo I spent some time in the library of the Middle America Research Institute, in New Orleans. I encountered several old maps that depicted Samana as a peninsula. Ten maps published from 1730 to 1929 showed Samana as an island and five from 1740 to 1837 showed it as a peninsula. Herbert W. Krieger considered it an island in 1929 (U. S. Nat. Mus. Bull., 147: 17-18); "The water channel through the Gran Estero from the bay (of Samana) to the Atlantic Ocean on the north was formerly sufficiently deep for purposes of navigation, but has become *partly closed* (italics mine) through uplift and with silt . . ."

Evidently Samana always has been (within historic times) and is today, a body of land *completely* surrounded by water. A letter dated 24 Nov., 1950, from the U. S. Navy Hydrographic Office, Washington, D. C., states: "The Strategic Maps of the Dominican Republic, published by the U. S. Marine Corps, 1922, show an area of impassable jungle swamp extending from the head of Samana Bay northwestward and northward to the Atlantic Ocean. Narrow channels of water are shown to cut through the swamp and, by some, may be regarded as sufficient evidence to establish the Province of Samana as an island."

Inasmuch as Samana apparently is not yet completely joined to the main island there is no telling whether there has ever been an interchange of individuals. It is doubtful that this small snake would enter brackish or salt water of its own accord. It is decidedly not a form likely to be

accidentally transported in baggage or produce. The natives dread snakes and would not be expected to transport one wittingly.

It seems more reasonable to assume that the entire eastern end of the island was and is favorable to the survival of melanistic individuals. Cochran's map shows a light or *protenus* record from Samana, but the text gives no clue to mode or date of arrival of the light form on the "peninsula"; there is no proof whether the black form was ever restricted there, or that the light form has not always been there. I took two of the black form on this trip at the very south edge of the island at La Romana.

It has been my experience that many forms are stopped by the slightest barrier and that spreading is a very slow process as evidenced by the local speciation or circumscribed ranges of such forms as *Sphaerodactylus*. On the other hand I know of several cases where an islet form also occurs on the main island, but only on the part immediately adjacent to the islet.

It would appear to me that *niger* and *protenus* are preferably to be considered as poorly differentiated subspecies, thus avoiding recourse to any theoretical eruption of the black form from Samana—whether island or peninsula—at least within historic time.

ROUTE 1, BOX 80, ESCONDIDO, CALIFORNIA.

ALLIGATORS IN WESTERN TEXAS.—References to the occurrence of alligators in western Texas are rare and pertain largely to the early part of the present century and to even earlier times. Mittleman and Brown (1948, Herpetologica, 4: 195) cite the early presence of alligators near San Antonio and Eagle Pass. Having been keenly interested in natural history while serving in the Army along the Mexican border in 1913-1914, and not having heard of alligators in the areas mentioned, I regarded the records as unreliable and perhaps based upon the alligator gar which abounds in creeks and springs of western Texas. Further inquiry among local residents provides confirmation, however, of the Mittleman-Brown records. Mrs. Ralph Jones in 1949 kindly relayed a direct and convincingly reliable report from a local cowhand, Mr. Perry Ellis, who observed alligators in Lake Espinoza, between Carrizo and Crystal City, Val Verde County. Seemingly secure reports were also available of two alligators seen by local residents in the summer of 1949 along the Rio Grande a few miles upstream from Eagle Pass.—Chapman Grant, Route 1, Box 80, Escondido, California.

A Collection of Reptiles and Amphibians From Cuba, With the Descriptions of Two New Forms

By ALBERT SCHWARTZ and LARRY H. OGREN

Since the publication of Barbour and Ramsden's "Herpetology of Cuba" in 1919, little additional information has been published regarding the herpetofauna of Cuba. Several new anurans have been described by Dunn (1925, 1926) Schmidt (1920), Barbour (1926), and Barbour and Shreve (1937), and these latter authors have described a new subspecies of *Celestus*. Barbour (1925, 1929), Barbour and Shreve (1935), Noble and Hassler (1935), and Ahl (1924, 1925) have described new anoles, and Cochran (1928) named a new *Deiroptyx*. Cochran also (1934) reported on a Cuban collection of reptiles and amphibians, and therein commented on the status of *Leiocephalus raviceps* Cope. Sutcliffe (1952) noted a small collection from Cuba. Grant (1944) described a new *Sphaerodactylus* from the island of Cuba. Bailey (1937) and Stull (1928) have concerned themselves with Cuban boids, and three new forms have been described. Wood (1939) resurrected two names for distinct populations of *Tretanorhinus variabilis* in Cuba, and Grant (1949) reconsidered the status of these snakes, describing *T. gaigeae* at the same time.

A small collection of 245 specimens taken in the winter of 1954 in the provinces of Las Villas and Oriente, Cuba, forms the basis of this report. Study of this material has revealed that two new forms are represented; the paucity of information on the distribution, natural history, and variation in Cuban amphibians and reptiles, and the interest in the herpetology of the West Indies, warrants a report on the material collected by us.

The present paper presents an annotated list of the amphibians and reptiles collected by ourselves and Daniel R. Stanland during the period of December 17 to December 31, 1954. Several residents of the Republic of Cuba were extremely cooperative in their assistance to us, and their help has resulted in our securing far more material than we would otherwise have obtained. We wish to thank Ing. Fernando de Zayas (Habana), Oscar Alcalde Ledon (Cienfuegos), and Efrain Eduardo Calderin (Santiago de Cuba) for their friendship and hospitality in many ways. Claude D. Bingham, whose coffee plantation, Los Bucares, lies in the Sierra Maestra on the Río Yao, was our genial host for two days, and his assistance and that of his staff were extended to us; collecting here resulted in the taking of a series of *Tretanorhinus* which we are describing as a new subspecies. Ian Ducan Clements of the Harvard Botanical Gardens at Soledad graciously allowed us to collect in the area under his administration, and the Reverend and Mrs. John C. Stroud (Methodist missionaries at Cienfuegos), and their son Robert were our hosts both at their home and at the site of the proposed Methodist Youth Camp in the Sierra de Trinidad. Our companian, Daniel R. Stanland, assisted our collecting in many ways, and we wish to thank him especially for his cooperation and assistance.

We wish to thank Charles M. Bogert and Richard G. Zweifel for the

loan of the type specimen of *Eleutherodactylus sierramaestrae* Schmidt and for making comparisons of specimens for us. Doris M. Cochran, Arthur Loveridge, George S. Myers, George B. Rabb, and Richard G. Zweifel have loaned us specimens for study, and George B. Rabb, who has had both field and laboratory experience with the genus *Leiocephalus*, has aided us considerably with the interpretation of our specimens of this genus from Cuba. Doris M. Cochran and Benjamin Shreve have checked certain identifications for us, and have generously offered information from their store of West Indian information.

The following abbrevations have been used: AMNH, American Museum of Natural History; AS, collection of Albert Schwartz; MCZ, Museum of Comparative Zoology; UMMZ, Museum of Zoology, University of Michigan; USNM, United States National Museum. Specimen numbers given in each species account are those of the Charleston Museum, unless otherwise indicated. All capitalized color names are from Ridgway (1912), and all measurements are in millimeters. The ventral scutes of all snakes have been counted in the manner proposed by Dowling (1951). Distances have been reckoned in either miles or kilometers, depending upon our automobile speedometer or local information as the source of the distance.

We collected at six principal localities which are described below, and several specimens were secured at places we only visited momentarily. These localities and such centers as "Caunao" or "Santiago de Cuba" are not described.

1) Harvard Botanical Gardens, Soledad, Las Villas Prov. These gardens are located at the Azucarero Central Soledad near Cienfuegos, and comprise both landscaped and primitive areas and fresh water pools, at an elevation of approximately 180 feet. The area includes limestone outcroppings, intermittent rocky streams in broad-leafed forest, banana and palm groves, and many acres of landscaped lawns; consequently the herpetofauna is varied and abundant. *Pseudemys decussata* was observed and collected here, but, since the turtles are to comprise the basis of an additional comprehensive paper, no mention of the variation and natural history of this species is made in the present paper.

2) Guajimico, 16 mi. SE Soledad, Las Villas Prov. The two major caves at Guajimico are situated in a high limestone cliff overlooking the Caribbean Sea. These caves are extensive and are reached by climbing up a rough cliff face to the entrances. The ocean reaches to the foot of the bluff and here specimens of *Leiocephalus carinatus* were collected.

3) 6 mi. S Manicaragua, Sierra de Trinidad, Las Villas Prov. This is the site of the Methodist Youth Camp, at an elevation of about 600 feet. The area is moderately under cultivation and has been recently partially cleared, but slopes covered with forest do occur locally, and steep-sided ravines harboring *Eleutherodactylus* were present. Superficial limestone caves also occurred in the vicinity at the top of a steeply sloping hillside, but rocky outcroppings were generally not abundant.

4) Finca Bucares, 22 km. S Bueycito, Oriente Prov. The *cafetal* of Claude D. Bingham lies at an elevation of 1000 feet in the Sierra Maestra on the Rió Yao. The mountain slopes are planted to coffee, and these planted areas are surrounded by the primeval forest. No collecting was

carried on in the forest itself because of the very dense vegetation and difficult progress. Immediately surrounding the main house of the plantation, *Anolis h. homolechis* was found to be abundant, and in general, lizards appeared to be more common in the clearings and vicinity of houses rather than in the forest itself. The Rió Yao yielded specimens of the water snake *Tretanorhinus variabilis*, and although the residents considered *Epicrates* as common, none was secured.

5) Aguadores, nr. Santiago de Cuba, Oriente Prov. The high limestone bluffs at the margin of the Caribbean Sea were visited and *Leiocephalus carinatus* was extremely abundant here. In the shrubby growth at the foot of the bluffs, *Ameiva auberi* were seen but none was secured.

6) 2 mi. N Santiago de Cuba, adjacent to the Carretera Central, Oriente Prov. Situated in the foothills of the Sierra Maestra, a dam and rocky ravine were visited and several forms were secured. The area was principally one of sloping hillside with tufts and bunches of waist-high grass, while the ravine sides were covered with a dense growth of shrubs and vines.

Hyla septentrionalis Boulenger

Harvard Botanical Gardens, Soledad, 11 (55.1.9-.10, AS 445); Caunao, Las Villas, 1 (55.1.11); Santiago de Cuba, Oriente, 1 (55.1.12); Finca Bucares, 22 km. S Bueycito, 3 (55.1.13, 55.1.15); Charco Mono Reservoir, 13 mi. NW Santiago de Cuba, Oriente, 7 (55.1.14).

Means and observed ranges of nine males from the above localities are: head and body, 68.8 (62.1-79.1); tibia, 29.0 (25.2-35.7); hindfoot, 29.3 (26.3-34.8); length of head, 22.7 (20.2-26.4). Six females from the same localities have the following measurements: head and body, 73.0 (62.3-88.2); tibia, 26.8 (22.8-32.0); hindfoot, 29.7 (24.0-36.3); length of head, 23.5 (20.0-27.9). None of the males has the inner side of the first finger covered with black rugosities which males of this species characteristically show during the breeding season. The smallest individual taken measures 31.7 mm. in head and body length. These frogs were all captured at night with the exception of one, which was found in a rolled plant leaf during the day. They were very abundant in the Botanical Gardens, where they were found perched on the leaves of palm trees and on bamboo stems. We heard one male calling in the evening of December 26, in the Sierra Maestra, and numerous tadpoles were observed in a cement drain in Santiago de Cuba on December 24.

Bufo peltacephalus Tschudi

Harvard Botanical Gardens, Soledad, 11 (55.1.49, AS 446); Finca Bucares, 22 km. S Bueycito, 1 (55.1.50).

Two females and ten males were collected. Both females contain large numbers of ovarian eggs which fill the body cavity. The measurements for these two individuals are: head and body, 144.6., 136.4; tibia, 33.3, 33.0; hindfoot, 52.1, 41.9; length of head, 43.8, 41.3. Measurements for the ten males (means and observed range) are: head and body, 122.8 (109.9-134.4); tibia, 31.0 (28.6-35.6); hindfoot, 44.0 (40.0-47.6); length of head, 37.5 (32.4-40.1). This toad was taken at night throughout the Harvard Botanical Gardens on the open ground surrounding the numerous ponds outside their burrows. A few toads were also taken among

piles of rocks, near the waters edge. They were very easily captured and only a few managed to escape down their burrows. The montane specimen from the Finca Bucares was encountered in the patio of the house, and another individual was seen among the mangroves near the coast at Guajimico.

Eleutherodactylus varleyi Dunn

2 mi. N Santiago de Cuba, 1 (55.1.66).

One male (head and body, 12.9) was secured in the ravine at this locality. It was seen hopping about on the rocks during the day. The color pattern is quite distinctive: a middorsal brown stripe (expanded in the eye region to form an interocular bar) extends from the snout to the groin, and is medially divided by a fine pale line which forks above the vent and continues onto the posterior surface of the thighs as far as the inner aspect of the knee. A canthal-postocular bar extends to above the insertion of the forelimb, and a dorso-lateral brown stripe extends from the posterior margin of the eye to the region of the sacrum.

Eleutherodactylus atkinsi orientalis Barbour and Shreve

Finca Bucares, 22 km. S Bueycito, 1 (55.1.64).

One immature individual (head and body, 11.7) was taken at night as it hopped along a trail during a light rain in the forest of the Sierra Maestra. The rosy coloration on the thighs is characteristic of the species even at such small size. This specimen represents the first record of *E. atkinsi* from the Sierra Maestra, and the first record of the subspecies *orientalis* from southern Oriente. Specimens from Cobre Range, Siboney, Santiago, and Guantanamo were regarded by Barbour and Shreve (1937: 383) as rather intermediate between *E. a. atkinsi* and *E. a. orientalis*, since they possess the black femoral spot (typical of *E. a. atkinsi*) and a dorso-lateral band (typical of *E. a. orientalis*). Our specimen lacks the femoral spot and possesses the dorso-lateral band; this condition indicates that the Sierra Maestra individual should be assigned to the subspecies *orientalis*. However, Barbour and Shreve (*op. cit.*: 382) also stated that "Juvenile specimens of typical *atkinsi* often cannot be distinguished from those of *orientalis*." Additional collecting of adults may show that the Sierra Maestra is occupied by the nominate form, or by intergrades between the two subspecies.

Eleutherodactylus greyi Dunn

Guajimico, 16 mi. SE Soledad, 1 (55.1.65).

A single immature male (head and body, 27.3) of this species was taken in the cave at Guajimico, hopping about on the ground during the day. No other specimens were seen on two subsequent (one diurnal, one nocturnal) visits to the cave. The dorsum is marbled, and an interocular bar and a canthal-postocular brown stripe, extending posterior to the insertion of the forelimb, are also present.

Eleutherodactylus sierramaestrae Schmidt

Finca Bucares, 22 km. S Bueycito, 11 (55.1.68) and five (58142-46) in the American Museum of Natural History.

Means and observed ranges of seven females are: head and body, 39.2

(26.8-51.2); tibia, 16.4 (12.3-23.0); hindfoot, 18.9 (13.5-25.2); length of head, 15.1 (11.0-19.4); diameter of tympanum, 2.3 (1.6-3.2); ratio of head length to diameter of tympanum, 6.6 (6.1-6.9). The same measurements for one adult male are: 28.8, 11.8, 13.4, 11.5, 1.9, and the head length/tympanum diameter is 6.1. The two largest females (head and body 50.3 and 51.2) have enlarged ova, while a third adult female (head and body 47.1) has the ovaries spent.

The variation in color in the present series is striking. Two specimens have dorsolateral light lines, and the remainder of the series is variously mottled with blacks and browns dorsally; an interocular dark brown bar is present in all specimens. The belly is immaculate centrally, but the throat, chest, and under sides of the hindlimbs are heavily spotted or flecked with brownish. In the young individuals, there are three dark lines on the thigh, but these lines are obscured in adults.

The problem of assigning these specimens to one of the three forms (*E. brevipalmatus* Schmidt, *E. sierramaestrae* Schmidt, *E. turquinensis* Barbour and Shreve) which inhabit the higher elevations of the Sierra Maestra is due to the inadequate recording of variation in the forms under consideration. Our material seems best to agree with the description of *E. sierramaestrae* since it lacks the webbing on the hind feet (characteristic of *E. brevipalmatus*) and does not have a distinct dermal flange or margin on the toes of the hind feet (characteristic of *E. turquinensis*). The head length/tympanum diameter ratio of the type of *E. sierramaestrae* (a male) is 4.8, considerably lower than the ratio of 6.1 for our single male. Zweifel (*in litt.*, 1955) has computed this same ratio for the type and paratype of *E. brevipalmatus* as 4.2 and 5.8; the higher ratio is that of the type (a female). These figures are again lower than those of our series. Until additional fresh material from the Sierra Maestra is forthcoming, it seems preferable to regard our material as *E. sierramaestrae*; much is yet to be learned regarding the relationships of the large leptodactylids in this eastern mountain mass.

This series of frogs was collected on the night of December 25, during and after a light shower. They were found on the rocks and shrubbery near the edge of a small stream. One male was calling from a vine overhanging the boulders in the stream. The single chirp-like call was of a short duration and was repeated at intervals of several seconds. The following evening, we returned to the same locality, but no *Eleutherodactylus* were seen or heard.

Eleutherodactylus ricordi planirostris (Cope)

Harvard Botanical Gardens, Soledad, 15 (55.1.44-.45); 6 mi. S. Manicaragua, Sierra de Trinidad, 1 (55.1.46).

The sixteen specimens of this frog fall into two categories regarding dorsal coloration and pattern; three have the dorsal stripe pattern and thirteen are mottled. These figures are comparable to those of Goin and Cooper (1950:7) for a series of sixteen individuals from Jamaica. The largest female in the lot measures: head and body, 24.2 mm.; tibia, 9.3 mm; foot, 11.2 mm.; head length, 9.1 mm.; horizontal diameter of tympanum, 1.6 mm. The largest male has the following measurements: head and body, 20.3 mm.; tibia, 8.3 mm.; foot, 8.9 mm.; head length,

8.0 mm.; horizontal diameter of tympanum, 1.4 mm. The smallest specimen taken has a head and body length of 10.8 mm. We caught these frogs during the day under rocks in a small dried stream bed. Collecting was more easily done at night at this same locality and around the edges of ponds. In the Sierra de Trinidad, the one individual was caught on the rocks in a small stream.

Eleutherodactylus cuneatus (Cope)

Harvard Botanical Gardens, Soledad, 8 (55.1.47); 6 mi. S Manicaragua, Sierra de Trinidad, 12 (55.1.48).

Of the series of 20 specimens of this frog secured by us, fifteen are of sufficiently large size that sex can be determined by dissection. There are no obvious external differences between the sexes, other than the larger size of the females. Means and observed ranges of seven males are: head and body, 22.2 (20.4-23.6); tibia, 8.1 (7.6-9.1); foot, 11.2 (10.6-12.0); head length, 8.7 (7.8-9.2); horizontal diameter of tympanum, 1.5 (1.3-1.6). The same measurements for eight females are: head and body, 32.4 (28.4-38.3); tibia, 12.7 (11.9-14.9); foot, 16.7 (15.5-18.4); head length, 12.7 (11.2-14.0); horizontal diameter of tympanum, 2.0 (1.8-2.3). The ratio of head length to diameter of tympanum in the males averages 6.0 (5.8-6.3) and in females 6.3 (5.7-6.8).

All specimens have the W-shaped scapular fold characteristic of *E. cuneatus* and a gray bar between the eyes, preceded by the tan snout. The femora are heavily and strikingly barred with black; there are three bars, the most distal of which terminates at the inner surface of the knee. The hind feet and tibia are likewise barred with black. The posterior surface of the femur is variously mottled with black and white. The lips show alternating black blotches and white lines. The ventral surfaces may be almost white with faint black stippling on the throat, or, at the other extreme, the throat and anterior half of the belly may be quite dark and heavily stippled with black. This latter condition occurs more frequently in the males, but the seven specimens of this sex are by no means constant in this dark pigmentation. The largest female contains enlarged eggs ready for deposition.

This species was collected on one night only in the Harvard Botanical Gardens following a light rain during the afternoon. None was seen previously, although the area had been visited before. The series from the Sierra de Trinidad was caught among the rocks and brush in a small stream at night. A few were captured during the day underneath rocks at the edge of the same stream.

Sminthillus limbatus limbatus (Cope)

Harvard Botanical Gardens, Soledad, 11 (55.1.42-.43, AS 449).

The eleven specimens of this tiny frog have the following measurements (means and observed ranges): head and body, 10.8 (8.5-12.4); hindfoot, 4.5 (3.3-5.2); length of head, 3.9 (3.4-4.3). A few specimens were caught during the day by turning over rocks in a stream bed. They were not easily captured as Barbour and Ramsden (1919:113) mention. Collecting at night for this frog was much more profitable, as they remained relatively immobile and were more easily secured.

Tarentola americana (Gray)

Guajimico, 16 mi. SE Soledad, 1 (55.1.40).

A single female (total length 158 mm., snout-vent length 92 mm.) was collected at Guajimico. This specimen agrees well with Barbour and Ramsden's description of this species, but has 16 rather than 17 rows of dorsal tubercles. The lizard was captured at night while it was moving about on the face of a rocky cliff, near a small opening to the cave. Three others were seen previously during the day in the numerous crevices of this and other openings, and one was observed at night on the wall of a boat house at Guajimico. Immediately inside another entrance to the cave, we came upon an individual obviously resting during the day on a ledge in the uppermost portion of a small chamber. The chamber was well lighted from above where the crevice continued out through the ceiling. After several unsuccessful attempts to secure the lizard, it finally escaped into a crevice. At a cave near Playa el Inglés (south of Arimao, Las Villas, on the coast) two more *Tarentola* were seen during the day in the same sort of situation.

It is interesting to note the relative abundance of this lizard and its diurnal habit of frequenting the "twilight zone" of the caves; this cavernicolous niche was not mentioned by Barbour and Ramsden (1919:116) for *T. americana.* For use of *T. americana* (Gray) in preference to *T. cubana* Gundlach and Peters, see Loveridge (1944).

Sphaerodactylus cinereus Wagler

Caunao, Las Villas, 1 (55.1.39).

One female (total length 61 mm., snout-vent length 32 mm.) was secured on the porch of a house in the village of Caunao at night.

One other gecko, of an undetermined species, was seen on the limestone outcropping in the Harvard Botanical Gardens during the day. It seems remarkable that no more *Sphaerodactylus* were seen during the period of collecting on the island.

Anolis equestris equestris Merrem

Guajimico, 16 mi. SE Soledad, 2 (55.1.54-.55).

Two males of this species were collected. These measure 427 mm. and 460 mm. in total length, with corresponding snout-vent lengths of 151 mm. and 164 mm. respectively. There are 62 and 63 scales around the body immediately caudad to the dewlap, which in life was pinkish or rose colored. Both of these specimens were caught in two coastal caves at this location. One individual was sleeping in a crevice near an entrance at night, and was captured quite easily. The other lizard was taken during the day from its perch on a stalactite inside the cave. Barbour and Ramsden (1919:134) refer only to the arboreal habits of this species, and do not mention any cave-inhabiting proclivities.

Anolis carolinensis porcatus (Gray)

Harvard Botanical Gardens, Soledad, 5 (55.1.24); Finca Bucares, 22 km. S. Bueycito, 14 (55.1.26); 2 mi. N Santiago de Cuba, 1 (55.1.25); Santiago de Cuba, Oriente, 1 (55.1.52). The six largest males vary in size between 175 mm. and 210 mm., and in snout-vent length between 60 mm. and 76 mm. Our four largest females are somewhat smaller, with

total lengths between 140 mm. and 147 mm. and snout-vent lengths between 43 mm. and 53 mm. The smallest specimen taken is a male, with snout-vent length of 35 mm. At Soledad, all the specimens were collected from a small wooden shelter housing a weather recording device in a banana grove during the day. None was seen in the surrounding wooded area. The majority of the specimens from Oriente were collected on or about the thatched huts at Finca Bucares.

Anolis spectrum Peters

2 mi. N Santiago de Cuba, 1 (55.1.63).

A single female (total length, 114, snout-vent length, 32) was taken at the above locality in a clump of waist-high grass; *A. argillaceus* was taken at the same locality. Barbour and Ramsden (*op. cit.*: 149) considered this species to be quite rare, and they also stated that Gundlach had found it only in the jurisdictions of Matanzas and Cárdenas. Later, Barbour (1930:142) concluded that *A. spectrum* aestivates completely, and that, during the rainy season, it is not uncommon over much of central Cuba. Our specimen was secured in mid-winter and was active at that time; it appears also to represent an easternmost record for this species. The lizard agrees well with the description given by Barbour and Ramsden (*loc. cit.*), but differs in certain details. The upper head scales are carinate rather than smooth, there are five enlarged keeled supraocular scales, the occipital is separated from the supraorbitals by three series of scales, and there are six infralabials. The coloration in life was a dull metallic brown above and cream-colored ventrally.

Anolis sagrei sagrei (Duméril and Bibron)

Harvard Botanical Gardens, Soledad, 16 (55.1.29, 55.1.31-.32); Caunao, Las Villas, 2 (55.1.30); 6 mi. S. Manicaragua, Sierra de Trinidad, 1 (55.1.33); Finca Bucares, 22 km. S. Bueycito, 2 (55.1.37-.38); 2 mi. N Santiago de Cuba, 6 (55.1.34-.35); Santiago de Cuba, Oriente, 16 (55.1.36).

Six adult males vary in total length between 130 mm. and 140 mm., while the six largest females vary in total length between 94 mm. and 115 mm. The snout-vent length in males is correspondingly greater, ranging between 46 mm. and 52 mm., while the snout-vent length in females varies between 33 mm. and 40 mm. The smallest individual, a female, is 48 mm. in length and has a snout-vent length of 18 mm.

This is a very common lizard as stated by Barbour and Ramsden (1919:143); it was captured in every locality visited by us, and was encountered on the ground, brush, fallen logs and boards, fences, and piles of debris. *A. s. sagrei* was found to be especially abundant in the vicinity of human dwellings.

Anolis homolechis homolechis (Boulenger)

Finca Bucares, 22 km. S. Bueycito, 24 (55.1.27-.28, AS 199); 6 mi. S Manicaragua, Sierra de Trinidad, 1 (54.1.67).

The three largest males with complete and unregenerated tails vary in total length between 129 mm. and 137 mm., while the three largest females range in total length between 98 mm. and 112 mm. The snout-

vent length of the six largest males varies between 47 mm. and 62 mm., while the corresponding measurements for the three females are 35 mm. to 37 mm. The smallest individual (tail incomplete) has a snout-vent length of 21 mm. These lizards were collected during the day on the wooded slopes and thatched huts of the *finca.* It was noted that the tails of the species would usually be curled up while they were at rest on the logs and fence posts. This characteristic habit has been previously mentioned by Barbour and Ramsden (1919:155).

Anolis lucius Duméril and Bibron

4.5 mi. E. Soledad, Las Villas, 2 (55.1.16); Harvard Botanical Gardens, Soledad, 3 (55.1.17,55.1.51); Guajimico, 16 mi. SE Soledad, 11 (55.1.18, 55.1.21, AS 448); 6 mi. S. Manicaragua, Sierra de Trinidad, 1 (55.1.19); Jibacoa, Las Villas, 1 (55.1.20).

Total lengths of three males with unregenerated tails vary between 167 mm. and 186 mm., while in four females this measurement varies between 139 mm. and 160 mm. Snout-vent lengths in six males range between 59 mm. and 66 mm., and the same measurements in five females ranges between 52 mm. and 55 mm. The smallest specimen is a female with a total length of 74 mm. and snout-vent length of 31 mm.

Barbour and Ramsden (1919:132), in the key to the species of *Anolis,* indicate that *A. lucius* is characterized by a round tail. Examination of the present series shows that this is indeed true of females, but males have a low median caudal crest, formed by the enlargement of the central row of scales. Smith and Willis (1955:86-7) have recently commented on the intraspecific variation in this character in *A. lucius.*

During the day we found this lizard on the limestone outcroppings throughout the Harvard Botanical Gardens, and in the Sierra de Trinidad. They were also abundant in the caves we visited, darting into the numerous crevices to escape capture. At night they were easily collected while they rested immobile on the rock faces of the entrances of caves. It was surprising to note that upon being captured, several of these lizards emitted a startling squeak, or a series of squeaks. They also made this noise when they were killed for preservation. Barbour and Ramsden (*op. cit.*: 172) stated that the local inhabitants believe that this lizard is responsible for the calling of *Eleutherodactylus.* Possibly they have captured *A. lucius* which demonstrated this peculiar noise, and then later attributed the chorusing of the frogs to the lizard.

Anolis argenteolus Cope

2 mi. N Santiago de Cuba, 2 (55.1.8).

Two individuals, a male with snout-vent length 47 mm., a female with snout-vent length 43 mm., were collected. Both have broken tails. These two specimens were collected on a concrete dam during the day. Several more were seen on the rocky sides of a ravine, at the same locality, where they escaped capture by running into the dense growth of vines and shrubbery.

Anolis argillaceus Cope

2 mi. N. Santiago de Cuba, 1 (55.1.7).

A female (total length 92 mm., snout-vent length 33 mm.) was secured just off the highway in a clump of waist-high grass.

Leiocephalus carinatus carinatus Gray

Guajimico, 16 mi. SE Soledad, 3 (55.1.23).

Three females from this locality have snout-vent lengths of 58 to 60 mm. The coloration and characteristics of these three individuals is discussed in the description of *L. c. aquaris*. The locality where these individuals were secured is at the foot of the sea cliffs at Guajimico; the lizards were seen sunning themselves on rocks and driftwood logs along the beach itself, and were captured when they sought refuge under rocks which were capable of being moved by hand. Several more were seen around a boat shed and on the cliffs in the immediate area.

Leiocephalus carinatus aquarius, new subspecies

Holotype. Charleston Museum 55.1.62, a male, taken at Aguadores, near Santiago de Cuba, Oriente Prov., Cuba, on December 24, 1954, by E. Eduardo Calderin, Larry H. Ogren, and Albert Schwartz.

Paratypes. Charleston Museum 55.1.22 (2), same data as holotype; UMMZ 110182, Guantanamo Bay, U. S. Naval Base, Oriente Prov.; MCZ 6921 (3), Santiago de Cuba, Oriente Prov.; MCZ 42483, coast south of Pico Turquino, Oriente Prov.; MCZ 11213, Cabo Maisí, Oriente Prov.; USNM 29586-7, Santiago de Cuba, Oriente Prov.; USNM 59202-3, Guantanamo Bay, Oriente Prov.; USNM 81658, Macola Hill, Guantanamo, Oriente Prov.; USNM 81673, Río Puerco, Oriente Prov.; USNM 81687, Cabo Cruz, Oriente Prov.

Diagnosis. Similar to *L. c. carinatus* as known from Las Villas and Habana provinces, but differing in coloration (gray rather than brown) and details of throat and dorsal pattern, and averaging more subdigital lamillae and less dorsal scales than the nominate subspecies.

Range. Known only from the southern coast of Oriente Province, Cuba, from Cabo Cruz to Cabo Maisí. Probably restricted to the coastal cliffs and bluffs in this area, although Barbour and Ramsden (*op. cit.*: 170) noted the occurrence of this species on the steep cliffs inland near the city of Bayamo. Later, Barbour (1935:119) commented that these lizards are "seldom seen inland, certainly never in Cuba."

Description of holotype. A male, snout-vent length of 67 mm. Supralabials 8, infralabials 8; subdigital lamelae of 4th toe (bi- and tricarinate scales), 27. Dorsal body scales in midline (including only carinate scales from posterior of head shields to directly above groin), 42. Details of head scalation as in Barbour and Ramsden (*op. cit.*: 169), and closely similar to the figure given by these same authors (*op. cit.*: pl. 14, figure 11). Dorsal ground color gray, with five widely spaced blackish punctae (involving two scales) in five longitudinal rows, separated by four scales. Head shields brownish-gray, completely unspotted. Dorsal aspect of limbs gray, inconspicuously barred with slightly darker gray transverse bars. Dorsal surface of tail inconspicuously banded transversely with gray on a lighter gray background. Sides with two prominent vertical black bars, 1 or 2 scales in width, extending slightly onto belly, and separated by three rows of gray scales; five gray vertical bands (continua-

tion of dorsal transverse bars) between insertion of limbs, four of which extend onto the ventral surface to the midline. Throat pattern (anterior to posterior) as follows: 1) an anterior transverse gray bar, two scales wide, at level of infralabial 2 and crossing second pair of chin shields on their anterior half; 2) a central continuous transverse bar, two scales wide, crossing chin at level of infralabial 4; 3) a pair of median bars, incomplete on the midline (each side separated by five scales from its mate), extending obliquely dorsally to the ear opening; a vertical ocular bar, unconnected to median bar, beginning dorsally on scales below infralabials 5 and 6, and extending to ventral edge of lower eyelid; 4) a pair of postero-laterally and then dorsally directed gray bars, two scales wide, extending from near midline to lateral surface of neck, and widening there into a black bar; on either side of midline, prolonged anteriorly for four scales into a pair of parallel lines; 5) a gray bar, two scales wide, again postero-laterally and then dorsally directed, forming a black shoulder patch dorsal to axilla; 6) a series of four gray, poorly defined, more or less parallel bars, involving two scales, directed laterally on throat and extending slightly onto chest. Venter grayish.

Variation. The variation in the fifteen paratypes is not striking; three fresh specimens (a juvenile, snout-vent length 35 mm.; subadult female, snout-vent length 55 mm.; adult male, snout-vent length 103 mm.) show the color and pattern characteristic of the holotype. All are gray dorsally, with head shields unspotted and gray or tan. Stejneger (1917:273) noted that a fresh individual from Santiago de Cuba had a uniformly dark head. The juvenile and subadult female have the black dorsal punctae poorly expressed, and the adult male amplifies this condition as expressed in the holotype. The throat pattern is similar to that of the holotype, but shows some variation. In the juvenile and the subadult female, throat bars (3) and (4) are incomplete on the midventral line, and the juvenile has the series of posterior bars only faintly indicated. In these three specimens the vertical ocular bar is continuous with throat bar (3) only in the juvenile, and in the remaining two individuals it is separated from bar (3) as in the holotype. The adult male has the black shoulder patch and a black postocular patch extending from the posterior margin of the eye above the ear to the level of the axilla prominently developed and bordered above and below by white scales. The twelve remaining paratypes are old, and color and pattern are often indeterminate. However, none possesses the head spots which are characteristic of *L. c. carinatus*, and, when determinable, the dorsal coloration is clearly gray rather than brown. It should be emphasized here that color plays a large role in the determination of subspecies of the genus *Leiocephalus*, and consequently old or faded material is of little use in such determinations. Where determinable, the throat pattern in the faded specimens resembles that described for the holotype and paratypes. There are never more than four complete transverse throat bars in all specimens of *L. c. aquarius* examined, and usually there are only two.

The sixteen specimens of *L. c. aquarius* show a variation in number of 4th toe lamellae of 22 to 27 (mean 24.3) and dorsal scales in the midline range between 37 and 44 (mean 40.3). *Comparisons.* The type locality of *Leiocephalus carinatus* Gray is customarily given as merely

"Cuba." With the description of a new subspecies of this lizard from the island of Cuba, it would seem appropriate to restrict the type locality of *L. c. carinatus* in order to affix the name to the suitable population. Malcolm Smith of the British Museum (Natural History) has checked the type of *L. carinatus* for us and stated (letter, February 14, 1955) that the lizard is in good condition, considering its age. There are no more restricted locality data than "Cuba." Presently, there are no spots visible on the head, and the dorsal coloration is described as "gray . . . feebly spotted with brown; sides heavily marbled with brown." There are 20 and 21 tricarinate lamellae on the fourth toes of the hind feet. Since coloration plays such a vital role in determination of subspecies of *L. carinatus,* the gray dorsal coloration and absence of head spotting of the type may be interpreted as due to age and fading. No specimens of *L. c. aquarius* may be described as being heavily marbled on the sides. The subdigital lamellae vary between 22 and 27 in *L. c. aquarius,* whereas counts of 20 and 21 occur in specimens of *L. carinatus* from the province of Habana. Considering that the city of Habana has been a prominent Caribbean seaport for considerable time, it is likely that Gray's specimen came from this vicinity, and it seems suitable to restrict the type locality of *L. c. carinatus* Gray to Habana, Habana Province, Cuba.

L. c. aquarius has been compared with *L. c. carinatus* as known from Habana and Las Villas provinces. Fresh material from Guajimico, 16 mi. SE of Soledad, Las Villas, was strikingly different from *L. c. aquarius* in life. In specimens from this locality (representing the subspecies *carinatus*) the dorsal color is brown (rather than gray) with a blue-green iridescence, and the ventral surface of the tail is bright yellow (rather than white). These Guajimico individuals also show profuse brownish spotting on the head shields, including the supraoculars and superciliaries. The spotting is perhaps most concentrated on the scales between the orbits, but occurs also on the snout. Not only do these fresh specimens show this spotting, but all other material examined from Habana and Las Villas provinces likewise has prominent head spotting, unless the scales have been lost. The dorsum is brown in ground color, and there are longitudinal series of dark brown dashes (three to four scales in length) where the transverse brown bands intersect the carinae of the dorsal scales. These dark dashes are especially prominent on the sides. The brown transverse bands on the dorsum are quite evident and give the animal a transversely banded appearance with a dark collar (immediately in front of the forearms), a condition which has not been observed in specimens of *L. c. aquarius.* The tail is conspicuously banded with dark brown and yellowish orange, and the hindlimbs are banded with darker brown transverse bars; these colors and pattern features are different from those of *L. c. aquarius.*

The throat pattern also differs from that of *L. c. aquarius.* In *L. c. carinatus* bands (1) and (2) are complete, and there is a remnant of band (3) to which the vertical ocular bar is attached, forming a V, the dorsal bar of which is the vertical ocular stripe and the posterior bar is the auricular stripe, and the apex of which is directed medially on the throat. The remainder of the throat is variously spotted, flecked or barred with black. Band (4) is represented in an extremely fragmented condition by a series of black dots, about three to four scales long; that this series

represents band (4) in *aquarius* is shown by the fact that they trend laterally and dorsally toward the black neck bar. The posterior portion of the throat has a series of longitudinal dashes, often more or less fused, about twelve scales long, and extending onto the chest, and usually about 6 in number. Thus the posterior half of the throat in *L. c. carinatus* gives the impression of striping, rather than of radial bars as in *L. c. aquarius*.

Nine specimens of *L. c. carinatus* examined show a variation in number of 4th toe lamellae of 20 to 25 (mean 22.7) and dorsal scales in the midline range between 39 and 45 (mean 42.2). These differences are slight, but with more abundant material it may be shown that *L. c. aquarius* has an average larger number of 4th toe lamellae and fewer middorsal scales than *L. c. carinatus*.

We have seen fourteen individuals from Pinar de Rió Province; these lizards have not been considered in the above discussion of *L. c. carinatus*, and *L. c. aquarius*. All old specimens, they have the head scales spotted as in *L. c. carinatus*, and thus resemble that form in this character. However, the throat pattern is apparently made up of a series of lines and complex reticulations unlike that described for either *L. c. carinatus* or *L. c. aquarius*. If *Leiocephalus carinatus* has a coastal linear range as Barbour (alone and with Ramsden) has pointed out, then variations in populations of this lizard are to be expected. Absence of cliffs, swampy coastal areas, rivers, embayments, and other geographical and topographical features of the coastline would be expected to isolate colonies of the *perrito*, and such isolation may tend to fix certain variable characters (principally coloration and pattern.) Whether such variations have become established in other portions of the island can be determined only by collection of series of specimens and careful determination of color and pattern when the animals are taken or shortly after preservation. Old and faded material, or specimens on which the scales are absent, present little evidence (except of the grossest sort) on which variation in these features may be discussed or observed.

These lizards abounded on the cliffs and ground in almost unbelievable numbers, but proved very difficult to capture without a gun. They were found sunning themselves on the rocks and on fishermen's huts near the water's edge, and would scurry up the face of the cliffs and into crevices at our approach.

Specimens examined (except *L. c. aquarius*). *L. c. carinatus*: *Pinar del Rió*, Baños San Vicente, 1; Mariel, 3; Cabañas, 10; *Habana*, between Cojímar and Habana, 2; Cajobabo, 3; Habana, 2; *Las Villas*, Cienfuegos, 2; Guajimico, 3.

Four species of the genus *Leiocephalus* occur in Cuba. Of these, *L. raviceps* Cope is poorly known; it seems to occur in eastern and central Cuba and has been reported from eastern Cuba (Barbour and Ramsden, 1919: 172-3) and from four localities in Oriente, and one in Camagüey (Cochran, 1934: 40). The remaining three species (*L. carinatus*, *L. cubensis*, and *L. macropus*) are apparently ecologically separated. *L. carinatus* Gray occurs about rocky shores and sea cliffs, and is widely distributed around the periphery of the island (see, however, Barbour and Ramsden, *op. cit.*: 170). *L. cubensis* Gray likewise ranges from Cabo de

San Antonio to Cabo Maisí, but is found in the lowlands and less elevated limestone ranges. It appears to be most abundant about the edges of cane fields. *L. macropus* Cope occurs in eastern Oriente, and is a highland form, replacing *L. cubensis* in suitable habitat. Of these four species, all occur in the Province of Oriente: *L. carinatus* along the coast, *L. macropus* in the highlands, *L. cubensis* in the lowlands and less elevated hills, and *L. raviceps* apparently with a coastal distribution.

Celestus delasagra delasagra (Cocteau)

Finca Simpathía, nr. Río Damuji, Las Villas, 1 (55.1.41).

A single specimen of this rare lizard was secured. The snout-vent length is 85 mm., and the tail is incompletely regenerated. There are 34 scale rows around the body, and three (rather than two as Barbour and Ramsden (*loc. cit.*; 175) indicate) enlarged chin shields in contact with the infralabials. This individual had been ploughed up in a field, and was given to us by Oscar A. Ledon.

Epicrates angulifer Bibron

Harvard Botanical Gardens, Soledad, 1(55.1.56); Guajimico, 16 mi. SE Soledad, 2(55.1.57); 6 mi. S Manicaragua, Sierra de Trinidad, 1 (AS 444).

All our specimens are females ranging in size from 1350 mm. to 1930 mm. in total length. The length of the tail varies between 91 mm. and 173 mm. Ventrals scutes number between 274 and 286 (two are thus a few scales lower in this count than Barbour and Ramsden (*op. cit.*: 187) record), and subcaudals range from 46 to 51; Barbour and Ramsden (*loc. cit.*) give the range of subcaudals as 50 to 85. The scale row counts on these four specimens are: 51-65-35, 51-69-39, 53-73-37, and 51-69-37. Only one agrees with Barbour and Ramsden's maximum number of scale rows at midbody, 65, and the remainder of our specimens exceed this number. The boa collected at Soledad was found at night on the margin of one of the numerous ponds; the snake was wet and had presumably been in the water. One of the boas captured in the cave at Guajimico was found during the day lying extended in an extremely low and narrow tunnel connecting several smaller chambers with the main part of the cave. Upon entering these chambers, we found the bat *Artibeus jamaicensis parvipes* (Rehn) to be very abundant. Barbour and Ramsden (*loc. cit.*) mention that *Epicrates* has been known to take station at the mouths of caves to prey upon the bats as they flew by. The taking of our specimen at the only possible exit for the bats lends support to this contention. The other Guajimico individual was secured during the night when it crawled into a small aperture near the floor of the cave and became trapped. The Sierra de Trinidad boa was taken at night as it lay coiled in the loose rocks just off the shoulder of a road.

Tropidophis melanurus melanurus (Schlegel)

Harvard Botanical Gardens, Soledad, 1 (55.1.53).

A single female of this form was secured by us. The total length is 676 mm., with the tail measuring 64 mm. There are 199 ventral scutes and 34 subcaudal scutes. The scale rows are 25-27-17. Stull (1928:40)

stated that the ventral scutes range between 198 and 224 (average 206), and the caudal scutes range between 32 and 51 (average 34.7). Barbour and Ramsden (*op. cit.*: 188-9) have erroneously recorded that the scale rows in *T. melanurus* are in 23 or 25 rows; Stull has shown that this species regularly has 27 or 29 scale rows at mid-body. This specimen was taken at night as it was crawling along the side of a greenhouse in the Botanical Gardens.

Tropidophis semicinctus (Gundlach and Peters)

Soledad. 1 (55.1.3).

A male, this specimen measures 365 mm. in total length, and the tail is 43 mm. long. There are 203 ventral scutes, and 37 subcaudal scutes. The scale rows on the body are 24-25-17. The number of ventral scutes is slightly lower than the minimum number recorded by Stull (1928: 45). The specimen has 24 black blotches on the deep orange to yellow ground color anterior to the vent, and 4 blotches plus a black tip on the tail. Stull (*op. cit.*: 48) has pointed out that all specimens examined by her had 25 scale rows at mid-body; Barbour and Ramsden (*op. cit.*: 188) erroneously stated that *T. semicinctus* has 21 or 23 scale rows, although they (*op. cit.*: 192) correctly mention that a specimen from Cienfuegos has 25 dorsal scale rows. This single individual was secured during the day from underneath a pile of bricks in the village of Soledad.

Tretanorhinus variabilis binghami, new subspecies

Holotype. Charleston Museum, 55.1.61, an adult male, taken at Finca Bucares, 22 km. S Bueycito, in the Río Yao, Oriente, Cuba (elevation, 1,000 ft.), on December 25, 1954, by Larry H. Ogren and Albert Schwartz.

Paratypes. ChM 55.1.58, eight specimens with the same data as the holotype; UMMZ 112131, USNM 136606, MCZ 53949, AS 443, with the same data as the holotype, except collected on December 26, 1954; MCZ 8475, Río Tana, Manzanillo, Oriente.

Diagnosis. Similar to *Tretanorhinus v. variabilis* from eastern Cuba except: dorsal blotches reach the fourth rather than the third scale row, first two scale rows pale (rather than first three as in *T. v. variabilis*), dorsal blotches three to four scales in width, dorsal blotches not reaching pale lateral scale rows, preoculars 1/1, 2/1, and 2/2 (usually 2/2 to 3/3 in *T. v. variabilis,* with abnormally 1/1 and 4/4).

Range. Known only from the type locality and Manzanillo, Oriente but presumed to occur throughout the Sierra Maestra.

Description of holotype. An adult male, total length 786 mm., tail 160 mm. (tip missing). Ventral scutes 154, subcaudal scutes in 50 pairs (terminal scale of tail missing); scale rows 19-19-17; preoculars 1/2; loreals 1/1; supralabials 8/8; infralabials 10/10; body blotches 32/29, extending to fourth scale row and 3 to 5 scale rows in width; tail blotches

7. Ground color of dorsum Olive-Brown; blotches Blackish Brown (2); supralabials suffused with whitish; infralabials Massicot Yellow, suffused with brown along the sutures (infralabials 3 to 7) or almost completely brown (infralabials 8 to 10); mental and infralabials 1 and 2, and anterior third of first chin shields spotted with brown; posterior two thirds of anterior chin shields and remainder of chin Baryta Yellow; beginning three scales anterior to first ventral scute, a brown midventral line, which continues more or less well defined to tip of tail; ventral scutes Olive-Brown, spotted laterally with yellowish, the overall effect being a dark brown ground color with scattered Pale Olive-Buff lateral maculations; first two scale rows paler than dorsum, the first scale row noticeably more so than the second; broad brown band at junction of ventral scutes and first scale row, the dark pigment located on the anteroventral corner of the dorsal scutes of scale row 1 and on the lateral tips of the ventral scutes; subcaudal scutes brown, suffused with whitish, and the continuation of the midventral line following the median subcaudal sutures to the tip of the tail; hemipenis with four basal spines, distally calyculate, equipped with three transverse rows of smaller spines between calyculate area and basal spines.

Variation. Of the series of thirteen paratypes, seven are males and six are females. Two males have incomplete tails, and consequently no count of subcaudal scutes can be made. The ventrals in the entire series (including the type) show an average of 156.3 (observed range 152-161), and the subcaudal scutes average 55.1 (observed range 48-62). The means and observed ranges of ventrals and subcaudals in males and females are: males, 154 (152-156), 59 (50-62); females, 159 (156-160), 51 (48-53). Scale rows at mid-body are 19 in all specimens; the scale row formula of 19-19-17 occurs most commonly (eight specimens), but the following formulae also occur: 20-19-17 (two specimens), 19-19-18 (one), 21-19-17 (one), 17-19-17 (one), 19-19-15 (one). The preoculars vary between 1/1 and 2/2, and in the following proportions: 1/1 (14%), 2/1 (14%), and 2/2 (72%). The loreals vary between 1/1 and 2/2 in the following proportions: 1/1 (43%), 2/1 (35%), and 2/2 (21%). Supralabials are usually 8/8 (11 specimens) but counts of 8/9 (one) and 9/9 (one) occur. Infralabials are customarily 10/10 (9 specimens), but three snakes have 10/11, and there are two individuals with counts of 9/10 and 8/9 respectively.

The difficulties of counting the body and tail blotches result from the indescriminate fusing and alternation of the lateral blotches at the dorsal midline. To overcome this difficulty, body blotches were counted separately on each side of the body. The maximum number of blotches counted was 35, and the minimum number 25. Discrepancies between blotch number on right and left sides vary between 0 and 5 blotches. The dorsal tail blotches vary in number between 3 and 15; lower counts are often due to the blending of the blotches with the ground color of the tail. In all specimens no dorsal body blotches encroach below the fourth row of scales, and occasional blotches stop at scale rows 5, 6, or 7.

Males range in total length between 256 and 829 mm., while females vary between 422 and 1114 mm. in total length. The ratio of length of

tail to total length in six males varies between .203 and .228, and in six females this ratio ranges between .155 and .183.

The variation in color and pattern of the thirteen paratypes is not striking. All are dark brown dorsally, with the dorsal body and tail blotches darker. In all but one, only the lower two scale rows are lighter than the dorsum, and in a large female (the only exception), only the first scale row is inconspicuously lighter than both the ventral scutes and the dorsal scales. The greatest variation in color involves the ventral scutes; at one extreme is a young female (total length 486 mm.) in which the entire abdomen is dark brown and each ventral scute has only a few lateral white flecks. At the other extreme is a female (total length 422 mm.) in which the white spotting on the ventrals is quite evident and bold, the general appearance being light with little dark ground color apparent. Usually the appearance of the venter is dark, despite occasional heavy stippling with whitish pigment. The brown line at the junction of the ventral scutes and the first dorsal scale row is broad and may involve as much as one-third of the first scale row as well as the very lateral tip of the ventral scutes. In some specimens the dark brown mottling extends onto the chin shields (which are practically immaculate in the holotype), thus giving the throat a flecked appearance.

Comparisons. Dunn (1939) and Wood (1939) have discussed the forms of the genus *Tretanorhinus* on the New World mainland and the West Indies respectively. Since that time Grant (1941) described *T. v. lewisi* from Grand Cayman, and in a later paper (1949) the same author described *T. gaigeae* from a brackish tidal estuary near Cienfuegos, Las Villas, Cuba. In the latter paper, Grant discussed a large series of *T. variabilis* from Soledad, and on the basis of his studies of this lot of material, considered *T. v. insulaepinorum* Barbour a synonym of *T. v. wagleri* (Jan), and *T. v. adnexus* Bocourt a synonym of *T. v. variabilis* Duméril and Bibron. Thus the island of Cuba is regarded as having three forms (*T. v. variabilis, T. v. wagleri, T. gaigeae*), while the Isle of Pines is also inhabited by *T. v. wagleri* and Grand Cayman by *T. v. lewisi.*

We have not examined the type nor any specimen of *T. gaigeae.* We have seen specimens from the Isle of Pines, Cuba, and Grand Cayman, representing Wood's forms *insulaepinorum, variabilis, adnexus,* and *wagleri,* as well as Grant's *T. v. lewisi.* We agree with Grant that *T. v. adnexus* is a synonym of *T. v. variabilis*; specimens from the provinces of Habana and Matanzas do not differ in detail from specimens from adjacent Las Villas and Camagüey. *T. v. wagleri* is different from the more eastern form; female *T. v. wagleri* from Pinar del Río usually have 21 scale rows behind the head (seven of eight specimens) and males usually have 19 scale rows behind the head (three of five specimens). *T. v. wagleri* is further differentiated from *T. v. variabilis* in that there are more subcaudal scutes in the former; male *T. v. wagleri* average 70 subcaudals (67-73) and females of the same race average 60 (58-61). These same data for *T. v. variabilis* are: males, 63 (60-65), females 49 (47-50).

Grant (1949) considered *T. v. insulaepinorum* Barbour a synonym of *T. v. wagleri.* Both races are characterized by 21 scale rows behind the

head. We have seen two specimens (MCZ 12536-7) from 2 mi. W Nueva Gerona, Isle of Pines, which have 21 scale rows behind the head. The scale row formulae of these snakes is 21-21-19, and both are adult females. However, none of the fourteen specimens of *T. v. wagleri* from Pinar del Río retains the neck scale row count of 21 at mid-body. All Pinar del Río snakes having 21 scale rows posterior to the head reduce this number to 19 at the midbody, and usually the scale rows are reduced even further to 17 anterior to the vent. Although we have seen only two *Tretanorhinus* from the Isle of Pines, we feel that, if the above differences between the Isle of Pines population and that of western Cuba are constant, *T. v. insulaepinorum* should be considered a valid race occurring on the Isle of Pines.

Comparison between *T. v. binghami* and *T. v. variabilis* is the most pertinent. Specimens of these two forms may be separated by the extent and width of the dorsal blotches and the number of scale rows involved in the pale lateral band. In *T. v. variabilis* the dorsal blotches usually extend as far as the third scale row; we have seen one specimen which is an exception to this; in this snake (AMNH 42838 from Habana), the dorsal blotches reach the fourth scale row, rather than the third. The pale lateral band is two scales in width in *T. v. binghami* and involves three scale rows in *T. v. variabilis*. Thus, the dorsal blotches touch the lateral band in *T. v. variabilis*, and do not do so in *T. v. binghami*; this difference is due to a combination of the wider lateral band and more ventral extension of the dorsal blotches in *T. v. variabilis*. The dorsal blotches are 3 to 5 scales in width in *T. v. binghami* and 1-4 scales wide in *T. v. variabilis*.

Scale differences between *T. v. binghami* and *T. v. variabilis* are slight. The ventral and subcaudal counts for *T. v. binghami* have been given above; these same counts for twelve male and thirteen female *T. v. variabilis* (means and observed ranges) are: males, 152 (148-155), 63 (60-65); females, 159 (157-163), 49 (47-50). No specimens of *T. v. binghami* has more than two preoculars on each side, and ten specimens have 2/2. Preoculars of 38 *T. v. variabilis* range from 1/1 to 4/4; usually (95%) this race has 2/2, 2/3, or 3/3 preoculars, and counts of 1/1 and 4/4 are considered abnormal. Loreals in *T. v. binghami* range between 1/1 to 2/2, while in *T. v. variabilis* loreals range from 1/0 to 3/3; in both subspecies the highest frequency occurs in the 1/1 category.

Attention should be called to one specimen, here provisionally regarded as *T. v. variabilis*, although it possesses a higher number (72) of subcaudals than is characteristic of that subspecies. This individual (USNM 56364, Santiago de Las Vegas, Habana) is a male, and probably represents the influence of *T. v. wagleri* on the Habana populations of *T. v. variabilis*. The snake is typical of *T. v. variabilis* in all other respects.

Habitat. All specimens of *T. v. binghami* collected by us were taken at night in the Río Yao, and in a small stream flowing through the Finca Bucares. The majority of these snakes were found in the more quiet areas of the stream near the bank. Several were caught in close proximity to each other at the ford below the *finca*. They were usually completely submerged, with their bodies looped around the rocks in the bottom of the stream. One individual was seen to strike at and catch a small fish

and finished devouring it while the snake was being held. Eleven of the specimens were secured in a relatively restricted area, which tends to indicate that this snake is probably abundant in suitable situations in the Río Yao.

Specimens examined (except *T. v. binghami*). *T. v. insulaepinorum*: *Isle of Pines,* 2 mi. W Nueva Gerona, 2. *T. v. wagleri: Pinar del Rio,* San Diego de los Baños, 3; Guane, 2; Baños San Vicente, 1; El Guama, 1; Los Baños, Viñales, 2; Pinar del Río, 4; Río Toco-Toco, Rangel, 1. *T. v. variabilis*: *Habana,* Santiago de las Vegas, 2; Lake Ariguanabo, 2; El Cotorro, 1; Habana, 1; *Matanzas,* Matanzas, 1; *Las Villas,* Central Soledad, 25; Baños de Ciego Montero, 1; Santa Clara, 1; *Camagüey,* Finca Sta. Teresa, about 8 km. W Camagüey, on Central Highway, 1; *Oriente,* Santiago de Cuba, 2; El Cobre, 1; *T. v. lewisi*: *Grand Cayman,* North Side, 4.

Alsophis angulifer angulifer Bibron

6 mi. S. Manicaragua, Sierra de Trinidad, 1 (55.1.5); Savilan-Finca El Roble, Cienfuegos, Las Villas, 1 (55.1.6).

A female from the Sierra de Trinidad measures 750 mm. in total length, with a tail 206 mm. long. There are 164 ventral scutes and 108 subcaudal scutes, while the scale rows are 15-17-13. The juvenile from Cienfuegos is 224 mm. in length, the tail measuring 74 mm., and the scale rows number 17-17-13. The umbilical scar is still present on the juvenile, and is located on ventrals 140-143; the specimen was not collected by us, but was taken by Oscar A. Ledon in October, 1954. The taking of such a small specimen with umbilical scar still present indicates that Alsophis young are hatched in the autumn. Upon preservation the individual from the Sierra de Trinidad regurgitated an *Anolis s. sagrei.* The adult specimen was collected during the day where the farmers were clearing away the brush on a mountain slope.

Leimadophis andreae andreae (Reinhardt and Lütken)

Harvard Botanical Gardens, Soledad, 1 (55.1.4).

A single female was taken by us; the specimen measures 440 mm. in total length, with the tail measuring 143 mm. There are 142 ventral scutes and 92 subcaudal scutes; the scale rows are 17-15-15. Another individual was seen under a palm frond during the day and a third was seen crawling through the thick vegetation a few inches above the ground.

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A Contribution to the Biology of the Skink, *Eumeces laticeps*

By BERNARD MARTOF

The general absence of information dealing unequivocably with *Eumeces laticeps* Schneider, especially with its life history, is no doubt due to its close anatomical similiarity to *E. fasciatus* Linnaeus and *E. inexpectatus* Taylor. In the last few years several specimens of *E. laticeps* have been collected in various parts of Georgia. Included among these are three large groups of hatchlings. They provide some interesting data on the general life history and form the main part of this report. It is hoped that these observations will promote a more intense study of this neglected species.

On September 18, 1955, an adult female with a snout-vent measurement of 95 mm. and a total length of 229 mm. was taken in Towns County near the top of Brasstown Bald on the east-northeastern slope at an elevation of approximately 4,400 feet. As might be expected, the terrain is generally rocky and well drained. The lizard was brooding eggs under a large rock, roughly 20 x 18 x 12 inches. The bottom of the rock was in close contact with the ground and it looked as though the lizard had burrowed through the loose loamy soil immediately adjacent to the rock. The burrow was about ten inches long and terminated almost three inches below the general level of the ground. The female, together with 15 eggs, was in a flattened, pocket-like depression at the end of the burrow. The eggs were dull brown in color, as was the soil. Apparently they had been moved about considerably by the female as she brooded them. Fitch (1954, Univ. Kans. Publ. Mus. Nat. Hist., 8) noted that turning of the eggs by brooding females of *E. fasciatus* prevented rotting of that part of an egg in contact with the ground.

The adult, with her eggs, was collected and placed in an indoor terrarium. On September 20, she ate eight eggs, shells included, and would have eaten more of them, had not a glass partition been placed in the terrarium, thus separating her from the eggs. Cannibalism again occurred on September 23 when she managed to climb over the partition and ate four more eggs. One of the remaining eggs was damaged by the adult as she fed. It contained a well-developed embryo with a snout-vent measurement of 27 mm. and a total length of 58.0 mm. The other two eggs were removed from the terrarium and placed in a finger bowl containing moss. They hatched during the afternoon of October 1. From snout to vent the hatchlings measured 28 and 30 mm. and in total length 58 and 65 mm., respectively.

Another large female skink with a snout-vent measurement of 107 mm. and a total length of 268 mm. was taken May 29, 1953, at Whitehall, Clarke County, Georgia. She too was placed in an indoor terrarium and on June 11 laid 16 eggs. They hatched on July 16, an incubation

period of 35 days. These hatchlings were outstandingly large. In snout-vent measurement they averaged 34.1 mm. and ranged from 32 to 35 mm. In total length they averaged 80.9 mm. and ranged from 76 to 85 mm.

It is interesting that during the period of incubation the adult was not fed and at no time was there any indication of cannibalism. Apparently hunger alone does not promote cannibalism (oöphagy) in *E. laticeps*. Taylor (1935, Univ. Kans. Sci. Bull., 23) reported that an adult *E. laticeps* fed on a specimen of *E. fasciatus* shipped in the same container. Very likely *E. laticeps* feeds on smaller lizards in nature, even though insects, arachnids, and small crustaceans constitute the bulk of its diet (Taylor, *op. cit.*)

A third clutch of eggs was taken by James C. Knepton, Jr. in southern Georgia about four miles east of Thomasville, Thomas County, on June 3, 1953. The nest was in a wooded area underneath a piece of tin roofing which was in close contact with the ground. In the laboratory the brooding female was separated from her 13 eggs. The eggs were kept in moist sand and on June 22-23 they hatched. In snout-vent measurement and total length these specimens averaged 32.8 and 76.0 mm. respectively.

One of the outstanding features indicated by these clutches is the seasonal differences involved. The specimens from Clarke and Thomas Counties laid and hatched their eggs at the usual period, coinciding with the few reported observations in other parts of the known range of this species. In Florida, for example, Carr (1944, Univ. Fla. Publ., 3) reported June 3rd as the date of laying and Goin and Goin (1951, Journ. Fla. Acad. Sci., 14: 29-33) indicated that early July is the time of hatching. Noble and Mason (1933, Amer. Mus. Nov., 619) reported that three females from Mississippi laid between May 23 and 28 and their eggs hatched between July 5 and 18. In Maryland, McCauley (1939, Copeia: 93-95) observed a somewhat later date of oviposition and hatching—a captive specimen laid on July 12 and hatching occurred close to the season of hibernation. Goin and Goin (*op. cit.*) indicate that near Gainesville, Florida, the adults go into hibernation in the end on September; the juveniles hibernate later, the last being seen on October 10. Surely specimens from almost 400 miles farther north and from a much higher altitude go into hibernation earlier. These data suggest that some *E. laticeps*' eggs do not hatch in the same season they are laid. Then too, it is possible that their eggs cannot endure winter conditions; consequently this factor may play a major role in limiting their northern distribution.

Furthermore, these data are outstanding because they represent the largest clutches of eggs known to be produced by a single female. There can be no doubt that the Clarke County record is that of one specimen. Regarding the Brasstown Bald and Thomas County clutches, there is no positive proof that each resulted from one lizard, although it is my impression that they did, especially the Brasstown Bald clutch. The chances of two specimens laying eggs in a common nest so late in the season are not very great. In fact there are no definite records of communal nesting

for *E. laticeps*. All previously reported clutches are considerably smaller: McCauley (*op. cit.*) observed a clutch of ten eggs from Queen Anne's county, Maryland; Noble and Mason (*op. cit.*) reported clutches of six, six, and seven eggs each from Mississippi. These are the only published records of clutches of *E. laticeps*.

Regarding the size of the hatchlings, the specimens reported here are unusual because of their large size. This is especially true of the Clarke County specimens. The only other record which approximates the large size of these animals is by Goin and Goin (*op. cit.*) who report a specimen, apparently a hatchling, which had a head and body length of 35 mm. and a total length of 85 mm. McCauley's six specimens from Maryland averaged 31.2 mm. in the snout-vent. Noble and Mason (*op. cit.*) reported 5 small hatchlings from Mississippi, these averaged 26.8 mm., range 25 to 30 mm.

Thirty-six adult specimens of *E. laticeps* have been taken, 25 of these are from Clarke County, most of the others are from the southern part of Georgia. Data from these specimens together with that from the hatchlings are contained in Table I. Also included for comparison are data from 24 Ohio specimens (Conant, 1951, Amer. Midl. Nat., 20) and from six Maryland specimens (McCauley, *op. cit.*)

Perhaps the most significant difference among these specimens is indicated by the number of scale rows at mid-body. Geographically this variation seems to be correlated with the Fall Line. Specimens from the Coastal Plain of Georgia average 32.2 scale rows while those from north of the Fall Line averaged 31.5 scale rows. These averages do not appear to be very different, however, only 4.6% of the northern specimens have 33 scale rows, while 30.0% of the Coastal Plain ones have 33. At the other end of the range of scale rows the difference is even greater: 53.5% of the northern ones have 31 or 30 scale rows against 5.0% of the Coastal Plain specimens. None of the latter have 30 scale rows while 25.6% of the northern specimens do.

It is also interesting to note that an appreciable difference in the number of scale rows at mid-body exists between adults and hatchlings. This is best indicated by a comparison of specimens from the Clarke County area. The hatchlings averaged 31.8 scale rows, having four specimens with 31, 11 with 32, and one with 38. On the other hand, the adults averaged 30.9, having 1 with 30, eight with 31, six with 32, and one with 33. This average for adults is somewhat less than the 31.3 obtained from Taylor's data (*op. cit.*) on 136 specimens from various parts of the geographic range. On the other hand, hatchlings from Thomas County averaged slightly less than did the six adults from the southeastern part of Georgia (Table I). Accordingly the difference between these adults and juveniles is probably a genetic one; i.e., peculiar to the samples examined.

An analysis of the ratio of the tail length to the snout-vent measurement revealed that the larger hatchlings have not only absolutely but also proportionately longer tails. The increase in the tail length with increase

in body size appears to be linear. The small hatchlings from Brasstown Bald have tails which average 1.13 times the snout-vent length. The next larger hatchlings, those from Thomas County, average 1.34. The very large hatchlings from Clarke County average 1.38 times their snout-vent measurement. Excluding all obvious cases of regeneration, the tails of adults are longer than those of juveniles. The adult specimens from Georgia average 1.46, range 1.18 to 1.64. These data are very similar to Conant's observations (*op. cit.*) that Ohio specimens average 1.47 and range from 1.19 to 1.68.

Table I. Variation in *Eumeces laticeps*. All measurements are in millimeters. Upper figures apply to hatchlings, lower ones to adults. T—tail length; SV—snout-vent measurement; TL—total length.

Location	Number of specimens	Scale rows at mid-body	Upper Labials	T S-V	Adults max. SV-TL	Hatchlings average SV-TL
Ohio	24	30.8	7.71	1.47	120-241	
Maryland	6	32.7	7.42			31.2
Georgia						
	3	31.3	8.00	1.13		
Towns County	1	31.0	8.00	1.41	95-229	28.3-60.3
	16	31.8	7.78	1.38		34.1-80.9
Clarke County	25	30.9	7.96	1.46	117-265	
Cobb County	2	31.5	7.75			
South-central part of state	2	31.5	7.50	1.18	115-241	
Thomas County	13	32.2	7.96	1.34		32.8-76.0
Southeastern part of state	6	32.5	7.80	1.45	110-250	

On the average the Georgia skinks have more upper labial scales than those from other parts of the range. Almost 92 percent of the specimens have eight upper labials compared to 71 percent of the Ohio specimens and 42 percent of those from Maryland.

All hatchlings have seven longitudinal white lines over the dorsum and sides of the body. Of these, the ventrolateral ones are the least persistent. They disappear in some specimens as small as 44 mm. in snout-vent measurement; however, they are present in other specimens as large as 100 mm. About 90 percent lose the ventrolateral stripes by the time they are 60 mm. snout-vent. In general, all stripes tend to be more persistent in females than in males. Most large males tend to lose all stripes, whereas practically all large females have five or more distinct stripes. There is no geographic variation evident from the specimens examined; however, Taylor (*op. cit.*) noted that eastern populations differed from the western ones by the juveniles being 7-lined instead of 5-lined.—

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A Taxonomic Study of the Relationship Between *Pseudacris nigrita triseriata* Wied and *Pseudacris clarki* Baird

By REXFORD D. LORD, JR. AND WILLIAM B. DAVIS

Because of controversy in the literature regarding the taxonomic relations of two members of the family Hylidae, namely *Pseudacris clarki* Baird and *Pseudacris nigrita triseriata* Wied, that occur together in parts of their range, we undertook a field and laboratory study of these frogs in the spring of 1952 to ascertain whether additional light could be thrown on the problem.

History of the Controversy. The two forms *P. clarki* and *P. triseriata* were originally described as distinct species. Later, Stejneger and Barbour (1933, check list N. Amer. Amphs. Repts. :31-32) lumped them both with the polytypic species *Pseudacris nigrita* Le Conte. Smith, 1934, Amer. Midl. Nat., 15:462-465) disagreed in part with this treatment and pointed out the dintinctness of *P. clarki;* he accepted the placing of *P. triseriata* as a subspecies of *P. nigrita.* Burt (1936, Amer. Midl. Nat., 17:774-775), however, reported that *P. clarki* and *P. n. triseriata* intergrade in southern Kansas (Cowley County) and maintained that the two are con-specific. Smith (1947, Herpetologica, 3:183-184) pointed out that in south-central Texas the two forms do not intergrade in the areas where they breed in the same rain pools. Bragg (1943, Wassman Collector, 5:129-140) based on studies in Oklahoma, supported Smith's contention that *P. clarki* is a distinct species, and he also (Bragg, 1947, Wassman Collector, 7:149-168) argued for the recognition of *P. triseriata* as a species distinct from *P. nigrita.* Schmidt (1953, check list of N. Amer. Amphs. Repts. :74) recognized *P. clarki* as distinct, but placed *P. triseriata* in the *P. nigrita* complex. The following accounts are concerned only with the relationships of *P. clarki* and *P. n. triseriata* in south-central Texas in the same general area reported on previously by Smith (1947, *loc. cit.*)

Distribution. The range of *Pseudacris n. triseriata* as currently known is generally central North America. The range of *Pseudacris clarki* is generally south central United States. The ranges of these two forms overlap from south-central Kansas south through Oklahoma and into Texas approximately as far as Victoria and Brazoria counties. In some places this overlap may be as much as 100 miles, although it is usually less than this.

Habitat. The habitat of *Pseudacris clarki* is the grassland prairies (Smith, 1950 Univ. Kans. Mus. Nat. Hist., Misc. Publ. 2:89; Bragg, 1943 *op. cit.*) although it is often found near the edges of woods along the eastern border of its range. The habitat of *Pseudacris n. triseriata* is usually swampy, marshy places (Smith, 1950 *loc. cit.;* Wright and Wright, 1949, Handbook frogs, toads :253. This frog is often found on the edges of wooded areas, and within the woods in temporary pools.

In the course of collecting these two forms for various investigations,

we also gathered considerable field information. It can be said that generally *P. clarki* prefers shallower and possibly more grassy situations and clearer water than *P. n. triseriata. P. clarki* is almost always found calling from the center of a clump of grass in which it is hidden from above as well as all around, whereas *P. n. triseriata,* although usually found calling from the middle of a clump of grass surrounded by water of a depth of 4 to 12 inches, will many times be visible from above. This is, of course, at night. In the daytime it is inadvisable for all practical purposes to attempt to locate specimens of either species, for they are so shy and so well hidden that great patience is necessary to locate them.

In the vicinity of College Station, Texas, both *P. clarki* and *P. n. triseriata* breed only in temporary rain pools, never in permanent water. It must be emphasized that every pool from which *P. n. triseriata* was taken or observed also produced some *P. clarki;* usually they were found together, calling at the same time. However, it was noted that in pools where *P. clarki* abounded *P. n. triseriata* was not common, but in ponds where *P. n. triseriata* was abundant, *P. clarki* was often just as abundant. In several small ponds a census of the calling males was taken by ear, and often there were equal numbers of both forms. Unlike Smith (1947, *loc. cit.*), who reported that the Brazos River seemed to form a rather effective barrier for *P. clarki,* restricting that form as to the west side of the river, we found this species in abundance as far as 18 miles east of the river; likewise, *P. n. triseriata* occurred as far as 20 miles west of the river and it is suspected that these distances can be extended with further observations.

It must be admitted, however, that *P. clarki* was not as abundant on the east side of the river as it was in an elongated pond filled with floating debris about two miles west of the Brazos River in Burleson County. On the evening of March 2, 1952, 30 specimens were easily collected from an estimated 300 calling males. *P. n. triseriata,* on the other hand, seemd to be more abundant on the east side of the river. This situation seems to be borne out by the locality of capture of specimens in the Texas Cooperative Wildlife Collection; 26 specimens of *P. clarki* are from west of the river in Burleson County, 16 from Brazos County east of the river. There are 36 specimens of *P. n. triseriata* from Brazos County and only one specimen from Burleson County.

Calls. The breeding call of the males of the two forms is quite distinct. Cope (1892, Proc. Acad. Nat. Sci. Phila., 44:333) remarks that ". . . the voice [*clarki*] differs from that of the form *triseriatus* in its more rapid utterance, and the greater distinction of the rising inflection at the end."

The call of *P. n. triseriata* is a series of 8 to 12 sharp clicks uttered in fairly rapid succession, each click rising slightly above its predecessor in inflection. Each series of clicks is followed by another series after a time interval approximately equal to that required for one series.

The call of *P. clarki* is similar to that of *P. n. triseriata* in its utterance, but there the similarity ends for the clicks of *P. clarki* are of a different quality from those of *P. n. triseriata* and, as Cope (1892, *loc. cit.*) stated, they are uttered more rapidly. Likewise each series is followed more rapidly by another series. Contrary to Cope's report, our observations

indicate that *P. clarki* has a less rising inflection toward the end of each series than does *P. n. triseriata*. Some specimens even have a nearly monotone call. Both calls were always completely distinct; never was any call heard that might have been termed intermediate between the two.

Breeding Season. While both forms appear to reach the peak of the breeding season together (about March 3 in Brazos County in 1952) it is somewhat significant to note that the first *P. n. triseriata* was caught January 27, 1952, whereas the first *P. clarki* was caught nearly a month later on February 18.

The temperature at 6:00 p.m. on January 27 was 56° F. The temperatures on February 18 and March 3 were both 69°. There was, however, an average temperature in the high seventies between February 18 and March 3. Baxter (1949, Journ. Colo.-Wyo. Acad. Sci.: 61) records that in Wyoming the height of the breeding activities for *P. n. triseriata* is reached when the temperature is above 50° F.

During the course of observations, especial watch was kept for cases of interamplexion between the two forms in nature. While this act, if observed, would not necessarily prove anything conclusive (for a breeding male at the height of the season will clasp nearly anything that appears animate and comes within his grasp), it would indicate the possibility of interbreeding. An absence of interamplexion, on the other hand, would indicate that some barrier (psychological or physiological) was operating to prevent the species from interbreeding. Although many clasping couples were observed in the field, we never witnessed a single instance of interamplexion.

In conclusion it can be said that on the basis of all the information at hand *P. clarki* apparently prefers more grassy prairie-like situations, is less tolerant of cold, and congregates for breeding in greater numbers than does *P. n. triseriata*. Also the two forms have distinctly different calls. Since both are found together in almost equal numbers in rain pools in Brazos County and still retain their identity completely, there must be some sort of isolating mechanism operating to prevent interbreeding.

Breeding Experiments. In the old as well as in the modern species concept, proof of absolute sexual incompatibility between two forms, either physiological or mechanical, provides an adequate basis for regarding the forms as distinct species. It was therefore felt that artificial breeding experiments between these two forms, even though carried out on a small scale, would shed some light on the controversy.

Screen-topped gallon jars were prepared with three or four inches of water and a floating piece of wood. Frogs placed in the jars were taken during the breeding season and most of the females had a clutch of eggs visible within them.

Three *P. n. triseriata* females were placed in separate jars each containing several *P. clarki* males. All three laid eggs that looked normal and when all the separate batches from a single female were totaled they averaged 200 to 400 eggs per female. None of these eggs developed, and although some showed microscopic evidence of gastrulation they did not go beyond that stage. Four *P. clarki* females were placed in jars with *P. n. triseriata* males and two of them laid eggs. One clutch failed to develop. In the other, consisting of nearly 600 eggs, the majority of the eggs underwent cleavage and most of them elongated enough so that

embryonic body and tail were visible. At first the embryos were ventral side up; later they rolled over so that the pigmented surface was up. At this time it was noted that fully one half of the eggs were not developing. Three days after the laying of the eggs about 25 of the embryos wriggled free of the egg covering. Nine days later 17 of the original 25 were still alive; it was impossible to determine what had killed the other eight. Slowly, day after day, the remaining larvae grew until after about 18 days they were large enough to metamorphose. Then, amid plenty of food, most of them started to decrease in size and some died. Twenty-six days after they had wriggled free of the egg capsules only seven were left, and several of these were degenerating.

Forty-two days after the first larvae had emerged from the eggs only three were still alive; only two of those that had died had been purposely killed for examination. On this day one of the larvae metamorphosed and was a miniature replica of a typical *P. n. triseriata.* This result banished a suspicion, held for some time when only one of five crosses produced larvae, that since the female *P. clarki* that produced the fertile eggs had been caught while in amplexus with a male *P. clarki,* perhaps some of the sperm from the male had adhered to her skin and had survived the time and transportation from the pond to the jar and thus fertilized the eggs that she laid that night in the jar. However, getting a *P. n. triseriata* from eggs laid by a female *P. clarki* establishes that a successful cross was made.

Interpretation of these results is difficult. First it should be noted that few crosses have been carried out with amphibians and little information is at hand with which to correlate these results. However, in a symposium given in Austin, Texas, in 1952, Dr. Albert P. Blair said, during his talk on the Isolation Mechanisms of Anurans, that generally the young frogs of interspecific crosses that have developed have always resembled one or the other of the parents, and they could not be distinguished from normal young of the species which they resembled. In a mimeographed paper distributed after the symposium, he reported that in some crosses which have been made between *P. clarki* and *P. n. triseriata* at least some larvae have resulted but there was no metamorphosis.

Genetically such results can be explained in several ways; the genes for color and color pattern of *P. clarki* could be hypostatic or recessive to those of *P. n. triseriata,* or *P. n. triseriata* could possess one or more pairs of chromosomes more than *P. clarki* and these extra unpaired chromosomes in the hybrid zygote could be over-dominant over the genes of *P. clarki.* Other explanations might be advanced, but more definite information will be available if and when a backcross is made. At any rate the results obtained are not what would be expected of two interbreeding or intergrading forms of a polytypic species. In such cases one would expect intermediate offspring. However, it must be remembered that the identification of the hybrid was based solely on color pattern and color, and it is possible that other unobserved or invisible characters, such as blood physiology, could be intermediate. It is unfortunate that females of both species are so difficult to acquire because the paucity of females prevented our having true controls in the experiment. The closest attempt at a control that could be made was to put the two females

of *P. clarki* that had not laid eggs in the presence of *P. n. triseriata* males in a jar with males of *P. clarki*. The results were negative; no eggs were laid there either. As was stated before, the paucity of data in this experiment makes it little more than an indication of the results that might occur if the experiment were carried out more extensively.

Osteology. Eighteen specimens of both forms were cleared and stained for osteological examination by the Potassium Hydroxide Alizarin Red-S, Methylsalicylate method. Ten more were prepared for examination by allowing dermestids to clean the skeletons. Considerable study revealed that no striking osteological differences exist.

Certain trends were noted in such things as the curvature of the clavicle, the number of teeth, the length of the head, etc., but the variation even among this small sample showed far too much overlapping of these differing trends to use them without large numbers of specimens to determine the means and deviations. Measurements were made of the bones of eight *P. clarki* and eight *P. n. triseriata*, and their lengths were divided into the body lengths to determine proportional trends. The results are as follows:

Length of bones into body length

	Pseudacris clarki	*Pseudacris triseriata*
Ilium	2.59-2.68	2.44-2.60
Femur	2.43-2.86	2.46-2.64
Humerus	4.32-4.89	4.20-4.88
Apico-Basal length of head	3.68-4.15	3.46-3.75

It must be stressed that this osteological examination was not an intricate one but was merely to determine if there were any outstanding osteological differences between the two species.

External Morphology. Probably the question regarding the relationship between *P. clarki* and *P. n. triseriata* arises from their external similarities. Especially after their preservation in alcohol, it is difficult to see differences between certain specimens of each species. Certainly they are closely related forms, because in form and proportion they are nearly identical and in range they are neighbors. Convergence is rather difficult to conceive in this particular case. It remains, therefore, after we have recognized the similarities to find the differences. Smith (1934, *op. cit.*: 462-463) has listed ten rather distinct differences to which we have little to add.

There is a significant difference in the coloration and pattern of these two species in life during the breeding season and there is little reason to believe that any great changes would take place later on in the summer. In life, *P. clarki* is usually blotched with green which is surrounded by a thin black border on a light gray background. These blotches or spots of green may vary enough to line up into rows of spots and even make distinct stripes, but they usually differ from *P. n. triseriata* by having their borders quite irregular in comparison to the rather regular, even borders of the stripes of *P. n. triseriata*. On the other hand, *P. n. triseriata* is usually striped with dark brown on a lighter brown background and is never spotted with green nor when spotted do the spots have a thin black border.

Also, *P. clarki* appears to have more chromatophores imbedded in the supramuscular fascia of the dorsal surface of the back.

Statistical Separation. Measurements were made of the 93 *P. clarki* and 49 *P. n. triseriata* in the Texas Cooperative Wildlife Collection. The body length of each specimen was measured in millimeters with the aid of calipers. Statistical methods were applied to determine the mean, standard deviation of the sample, and the standard error of the mean for the population. The results are as follows:

	Pseudacris clarki	*Pseudacris triseriata*
Mean	29.12± .67	26.59± .68
Standard deviation of Sample	4.69	6.53
Standard error of the mean for the population	.67	.68

The mean length of the tibia of 49 *P. n. triseriata* was 13.29± .60; that of 93 *P. clarki* was 12.38± .49. The proportion of the mean length of the tibia to the mean length of the body of both species (that is, the mean body length divided by the mean tibial length) was 1.43 for *P. n. triseriata* and 2.15 for *P. clarki*. This indicates that the tibia of *P. n. triseriata* is significantly longer than that of *P. clarki*.

In interpreting these data it is statistically sound to say that 99% of the population lies within plus and minus 2½ standard errors of each other (that is, outside of 99% of either population), the samples are from two different populations. Thus, since the mean snout-vent lengths of *P. clarki* and *P. triseriata* are separated by more than 2½ standard errors of the mean, they are two separate populations.

SUMMARY

In an attempt to determine the relationships between *P. clarki* and *P. n. triseriata* much time was spent in the field studying the animals in an area where both species occur together. Both species could immediately be distinguished by sight and by call, and never was there any confusion caused by intermediates as might be expected if intergradation did occur. The two species were often found together in equal numbers in some small ponds.

Inconclusive breeding experiments indicated a separation of the species on a physiological basis.

Osteological examination of 28 specimens failed to reveal a consistent and distinct difference between the two forms, although some slight trends were noticed in the length and curvature of the bones.

Statistical analyses of the measurements of 142 specimens of both species demonstrated that the samples of *P. clarki* and *P. n. triseriata* were from two different populations. Since the specimens measured were from an area of supposed intergradation, these results contradict the supposition of interbreeding.

Consequently application of the modern species concept leaves no reasonable alternative to recognition of *P. clarki* and *P. n. triseriata* as species completely distinct from one another.

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Extensions of Known Range of Certain Amphibians and Reptiles of Mexico

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In the Museum of Natural History, University of Kansas, there are specimens, collected by Albert A. Alcorn, and J. R. Alcorn, and Robert W. Dickerman in the years 1950-1954, that provide noteworthy extensions of known geographical range or that are of interest for other reasons as explained below.

Species recorded for the first time from certain states are as follows: Aguascalientes, *Bufo occidentalis;* Coahuila, *Bufo compactilis speciosus;* Michoacán, *Bufo perplexus;* Oaxaca, *Hemidactylus frenatus;* Puebla, *Hypopachus alboventer alboventer;* Tamaulipas, *Bufo compactilis speciosus;* Zacatecas, *Bufo punctatus, Sceloporus poinsetti.*

Siredon lermaensis Taylor

An adult (KU 38099) from 3 mi. NNW Tenango, State of México, provides the second record station of occurrence since the type description by Taylor (1939, Univ. Kans. Sci. Bull., 26: 427-30), and extends the known range southwestward 12 miles from Lake Lerma.

Pseudoeurycea belli (Gray)

One individual (KU 37774) from 3 mi. WSW Mazamitla, Jalisco, provides a new locality in Jalisco for this salamander, and extends the known range of the species southeastward 59 miles.

Bufo compactilis compactilis Wiegmann

In one female (KU 38225) from Jiquilpan, 4800 ft., Michoacán, the venter is lightly spotted, and the dorsal spots are small, numerous, and well defined. The cranial crests are low and poorly developed. Only the latter feature fails to agree with the characters of the subspecies as defined by Smith (1947, Herpetologica, 4: 7-8). The specimen provides an additional locality for this toad in Michoacán, a state from which there are few records.

Bufo compactilis speciosus Girard

A large female (KU 38228) from 3 mi. N. and 4 mi. E. San Francisco, 4850 ft., Coahuila, and an adult male (KU 33996) from Soto la Marina, Tamaulipas, are the first records of this toad in these states. Both specimens agree well with the description (Smith, *op. cit.*) of the subspecies.

Bufo microscaphus Cope

Riemer (1955, Herpetologica, 11: 20) recently added this species to the list of amphibians of Mexico. Three specimens (KU 33901-02, 33915) from two localities in Durango were assigned to *Bufo c. compactilis* by Chrapliwy and Fugler (1955, Herpetologica, 11: 121). Upon re-examination, in the light of Riemer's report, these are reassigned to *B. microscaphus.* The specimens agree with the description by Stebbins (1951, Amph. Western N. Amer.: 257-258) of the species. All possess a brown inner metatarsal tubercle that is rounded and blunt-edged, a

brownish and conical outer metatarsal tubercle, and a well-defined thenar tubercle. The venter in all three is dark-spotted, a condition seemingly not typical in this species.

Bufo debilis kelloggi Taylor

Fourteen specimens (KU 37840-53) from 2 mi. SW Rosamorada, Nayarit, extend the known range southeastward 29 miles, and provide a second record-station in Nayarit. *Bufo d. kelloggi* has been previously reported in Nayarit only from Acaponeta. I follow Sanders and Smith (1951, Field and Lab., 19: 141-160) in considering *kelloggi* a subspecies of *Bufo debilis*.

Bufo occidentalis Camerano

Specimens of this toad are present from three states. Aguascalientes: 18 mi. W and 2 mi. S Aguascalientes, 6000 ft. (KU 29771-72). Durango: 2 mi. NW Nombre de Dios (KU 38212-16). Jalisco: 1 mi. S Jalostotitlán, 5700 ft. (KU 38217); 14 mi. WNW Guadalajara, 6200 ft. (KU 29773); and 4 mi. W Mazamitla, 6600 ft. (KU 29770). This species has been unrecorded from Aguascalientes. The specimens from Durango provide the first authenticated locality in the State. The species was reported previously from Milpas, Durango, which may not represent the name of a town (Riemer, *op. cit.*).

Bufo perplexus Taylor

One specimen from Río de Tepalcatepec, 17 mi. S. Apatzingán, Michoacán (KU 29775), is the first to be recorded from the State. The species has been reported from the states of Chiapas, Guerrero, Morelos, and Oaxaca.

Bufo punctatus Baird and Girard

Riemer (*op. cit.*)was the first to report *B. punctatus* from Durango. One specimen from SE end Laguna Santiguillo, Santa Cruz (KU 38077), and one from 5 mi. N Durango, 6400 ft. (KU 29049), provide two additional localities for this toad in Durango. A specimen from 3 mi. SW Jalpa, 4600 ft., Zacatecas (KU 29796), is the first to be recorded from that State.

Agalychnis dacnicolor (Cope)

This hylid has been reported from the state of Oaxaca only from Tehuantepec. One individual from Chacalapa, 2500 ft., Oaxaca (KU 38198), represents a range extension southwestward of 90 miles.

Hypopachus alboventer alboventer Taylor

This subspecies, from which Davis (1955, Herpetologica, II : 71-72) segregated *H. a. reticulatus*, previously was known from only two localities, both in Morelos. There is one female from 2 mi. N Izúcar de Matamoros, 4250 ft., Puebla (KU 38272).

Hypopachus cuneus cuneus Cope

For Tamaulipas, three specimens from 1 mi. S Altamira (KU 33977-79) provide the second known occurrence for this subspecies; the other occurrence was at 4 mi. W Forlón.

Hypopachus oxyrrhinus Boulenger

One individual (KU 38273) from 2.5 mi. E Tepatitlán, 6200 ft., Jalisco, extends the known range of this species northward 32 miles from Ocotlán, Jalisco.

Hemidactylus frenatus Schlegel

This gecko was reported previously from Mexico only from the state of Guerrero. There are three specimens (KU 38221-23) from Puerto Angel, Oaxaca.

Holbrookia maculata dickersonae Schmidt

In Coahuila, this lizard has been reported only from the southern part. One male (KU 38103) from 14 mi. E and 16 mi. N Ocampo, in northern Coahuila, is referred to this subspecies. A large blue patch surrounds the lateroventral black spots on the venter.

Sceloporus olivaceus Smith

In Coahuila, this species has been recorded only from Saltillo. One specimen (KU 38224) from 16 mi. E and 18 mi. N Ocampo, Coahuila, extends the known range northward 172 miles.

Sceloporus grammicus grammicus Wiegmann

A specimen (KU 38104) from Oaxaca de Juarez, Oaxaca, extends the known range 55 miles northward within the State. This species was previously known in Oaxaca from two localities in the southern part of the State.

Sceloporus heterolepis Boulenger

Five specimens (KU 38063, 4 mi. S Mazamitla; KU 37827-30, 3 mi. WSW Mazamitla) from eastern Jalisco provide additional record-stations for this lizard, previously reported in Mexico only from western Jalisco.

Sceloporus poinsetti Baird and Girard

Two individuals (KU 38097-98) from 2 mi. W Sain Alto, Zacatecas, are the first to be reported from the State.

Sceloporus ornatus caeruleus Smith

Three specimens (KU 37916-18) from 4 mi. N and 21 mi. W Cuatro Ciénegas, 6200 ft., Coahuila, provide the third locality record for this species in Mexico, and extend the known range 102 miles northward.

Sceloporus jarrovi oberon Smith and Brown

This subspecies is represented in the collection by three specimens (KU 37725-27) from 5 mi. W and 22 mi. S Ocampo, 6000 ft., Coahuila. These specimens provide a range extension northward of 153 miles.

Sceloporus parvus parvus Smith

Sceloporus p. parvus has been previously reported in Coahuila only from Arteaga. One specimen (KU 38102) from 16 mi. E and 18 mi. N Ocampo, Coahuila, provides a range extension northward of 174 miles.

Stenorrhina freminvilli freminvilli Duméril, Bibron, and Duméril

An adult male (KU 38089) from Chacalapa, Oaxaca, extends the known range southward 41 miles. The specimen measures 530 mm. total length, 81 mm. tail length, and has 167 ventrals, 38 subcaudals, 1-⅔ temporals, 7-7 supralabials, 6-6 infralabials, 1-1 loreals, 1-1 preoculars, 2-2 postoculars, 17-17-17 scale rows, and the anterior half of the nasal fused with internasals.

Tantilla atriceps (Günther)

This snake has been reported from only two localities in Coahuila (Ciudad Allende and near Saltillo). One individual (KU 38200) from 12 mi. E and 18 mi. N Ocampo, Coahuila, provides a slight extension of known range westward. The specimen measures 204 mm. total length, 44 mm. tail length, and has 2-1 postoculars, 139 ventrals, 1-1 temporals,

and 51 caudals.

I am indebted to Drs. Edward H. Taylor and Hobart M. Smith for various courtesies, to Messrs. W. Leslie Burger and John P. Lamb for helpful suggestions, to Mr. John M. Legler for permission to examine specimens in his care, and to Dr. E. Raymond Hall for critical assistance with the manuscript.

Museum of Natural History, University of Kansas, Lawrence, Kansas. *(Transmitted November 15, 1951.)*

RECORDS OF THE CENTRAL PLAINS SPADEFOOT TOAD, *SCAPHIOPUS BOMBIFRONS* COPE, IN SOUTH DAKOTA AND WYOMING.—The central plains spadefoot toad, *Scaphiopus bombifrons* Cope, has been reported from only a few localities in South Dakota and Wyoming. Therefore it is deemed worthwhile to place on published record the following notes.

William H. Over (Univ. South Dakota Nat. Hist. Studies, no. 6, pp. 1-31, mimeographed, 1943) reported *S. bombifrons* (on the basis of specimens in the Museum of the University of South Dakota) "only from Corson County." Hobart M. Smith (Amer. Midl. Nat., 50:434, 1934) reported this species from Buffalo, Harding County (KU Nos. 5196-5200). Grace L. Orton (Copeia, no. 2, p. 98, 1954) mentions larvae of this toad from near Kadoka, Jackson County (UMMZ Nos. 76558-59). These are, seemingly, the only published records of *S. bombifrons* from South Dakota.

In September, 1954, James S. Findley obtained three specimens (JSF 2166-68), and on May 25, 1955, five additional specimens (JSF 2169-73) of *S. bombifrons* from window pits on the campus of the University of South Dakota at Vermillion, Clay County, South Dakota. The toads range in size from 29 mm. to 42 mm., snout to vent length. These specimens extend the known range of this species some 240 miles eastward from the nearest previously reported locality (Kadoka, Jackson Co.), and provide the northeasternmost record-station in the United States for this toad. Since Vermillion is not far from the Iowa state line, a careful search probably will reveal the presence of the central plains spadefoot in Iowa.

George T. Baxter (Wyoming Wild Life, pp. 1-8, 1947) cites records of *S. bombifrons* from Yellowstone National Park and Laramie and Platte counties in Wyoming. In the collections of the Museum of Natural History, University of Kansas, specimens of this species provide additional distributional records for this spadefoot in Wyoming as follows: 8 mi. S and 8 mi. W Worland, 4200 ft., Washakie Co. (KU 29405); 7 mi. S Basin, 3900 ft., Big Horn Co. (KU 27843-27858); 20.3 mi. N and ½ mi. E of intersection of highways 59 and 387, Campbell Co. (KU 27840); 2 mi. S and ¼ mi. W Rocky Point, Campbell Co. (KU 27841); and 3 mi. S and 2 mi. E Rocky Point, Campbell Co., *in* Crook Co. (KU 28742). The latter specimen was taken from a gopher burrow.—*Pete S. Chrapliwy and James S. Findley, Museum of Natural History, University of Kansas, Lawrence, Kansas, and Department of Biology, University of New Mexico, Albuquerque, New Mexico.* *(Transmitted November 16, 1955.)*

After this manuscript was in press, Dr. Frederick A. Shannon kindly called our attention to a specimen of *S. bombifrons* from 2 mi. NE Shoshoni, Fremont Co., Wyoming (UMMZ 68966).

A Subspecies of the Lizard *Sceloporus undulatus* From the White Sands of New Mexico

By CHARLES H. LOWE, JR. AND KENNETH S. NORRIS

Populations of three species of lizards are known to be endemic to the White Sands of New Mexico, and a fourth (*Uta stansburiana* Baird and Girard) may also be endemic. These populations are unique for their remarkable and genetically fixed concealing coloration. This coloration consists of whitened dorsal colors and obscured dorsal color pattern. All forms must have been derived from "normal" dark colored animals in the Alamagordo Valley, which completely surrounds the populations of the White Sands.

One of these lizards has been described as the subspecies *Holbrookia maculata ruthveni* Smith (1943, Zool. Ser. Field Mus. Nat. Hist., 24: 339-344). The population most strikingly colored of all, that of *Cnemidophorus inornatus* Baird, will be described in a revision of that species by the senior author. The whitened population of *Uta stansburiana* remains little known.

The population of *Sceloporus undulatus* Latreille is described here as a new subspecies. It is an unusually distinct form and is restricted to the White Sands. Twenty-three specimens including two hatchlings were available for study. All were collected by us (1947-1950) and also studied originally as living or fresh specimens, prior to preservation.

The twenty-three specimens have been compared to the ecologically adjacent and normal-colored brown *S. undulatus consobrinus* Baird and Girard. Comparisons have been made in the field and in the laboratory and have involved 30 specimens of *consobrinus* drawn from various localities in southern New Mexico including those immediately surrounding the White Sands. One cannot well appreciate the great divergence in color pattern that is represented by the populations on the White Sands unless he has studied the problem at first hand. Some who have not studied the problem in the field, or who are not familiar with genetic variation in these kinds of animals, may be skeptical of the probable genetic control of the color differences obtaining. The reports of Benson (1933, Univ. Calif. Publ. Zool., 40: 1-70) and of Smith (*op. cit.*) should be consulted. Smith (*op. cit.*) reports upon some important laboratory experiments by L. C. Stuart.

We have conducted similar laboratory experiments with several individuals of this earless lizard, swift, and whiptail maintained in cages in Los Angeles for several months to slightly over one year. None of these animals changed their basic white and whitish colors. In Tucson, the senior author experimented further with three adult individuals of the *Sceloporus* and two of the *Cnemidophorus*. All were kept alive for approximately two years after capture on the White Sands. They were given a diet of meal worms, other insects, and available water. Their colors were checked with the aid of Ridgway (1912, Color Standards and Color Nomenclature) and Maerz and Paul (1930, Dictionary of Color). These animals were experimentally subjected to high and low temperature extremes, wide variation in relative humidity, and extreme variations in

color and texture of the substratum. These experiments will be described in more detail elsewhere. As might be expected, the only response that was found on the part of *S. undulatus* was the usual one to low temperature seen in many species of *Sceloporus*. This consisted of the usual change in albedo with the slight darkening at low temperatures that is well known in the subspecies of *S. undulatus* and many other species of *Sceloporus*, other iguanids, and some snakes occurring in our deserts. In *S. undulatus* the change is not particularly great, most apparent at temperatures below about 20° C., and there is immediate resumption of the characteristic colors at normal, higher body temperatures. There is no change in the color of the individual that is not simply the result of the degree of dispersion of melanin within the melanophores as a result of the body temperature. There was no change in the colors which remained fully as white at normal temperatures (*e.g.*, at 35° C. in the normally preferred or eccritic range) after two years in captivity as at the time of capture on the White Sands. Under no conditions of relatively low or high temperature do the colors of the animals from the White Sands remotely resemble those of any other population in the genus *Sceloporus*. The hatchlings of this population are, as in others, colored like their adults and are more like the adult females than like the males.

Various aspects of the general problem have been in progress over the last nine years. From several lines of evidence we have demonstrated to our satisfaction that the lizards of the White Sands are genetic ecotypes and not ecophenotypes, with the possible exception of the little-known population of *Uta stansburiana*.

*Sceloporus undulatus cowlesi** subsp. nov.

WHITE SANDS SWIFT

Holotype. University of Arizona No. 682. Collected August 22, 1949, at White Sands, 3 miles northwest of the Monument headquarters, Otero County, New Mexico, by Charles H. Lowe, Jr., and Kenneth S. Norris.

Paratypes are deposited in the Harvard Museum of Comparative Zoology, Chicago Natural History Museum, University of Illinois Natural History Museum, University of California Museum of Vertebrate Zoology, and the University of Arizona.

Diagnosis. A uniquely whitened form of *Sceloporus undulatus* with a broad light blue middorsal stripe extending from occiput onto the base of the tail. This stripe is 4 to 5 scales wide at midbody and is bordered by narrow light tan paravertebral stripes (occasionally series of spots) 1 to 2 scales wide, which are in turn bordered by white dorsolateral stripes 1 to 2 scales wide. Hatchlings are whitened like the adults and have a color pattern much like adult females. The two prefrontal scales are in contact at the midline (95% of sample). The subspecies is without a median prefrontal.

*Named in honor of Professor Raymond B. Cowles of the University of California, Los Angeles.

Description of the holotype (colors from the fresh specimen). Adult male, 60.2 mm. snout to vent, tail incomplete, with 11 mm. of regenerated tip. Toes 2, 3 and 4 are missing from the right hind foot. Femoral pores 14/15 with four scales between series. Two prefrontal scales, in contact on the midline. Forty-two scales on the dorsal midline from occiput to a point opposite the posterior margin of the thigh. General scalation as in *Sceloporus u. consobrinus.*

On the middorsal surface of the body there is a broad light blue stripe, 4 to 5 scales wide at midbody, extending from the occiput onto the base of the tail. This wide light blue central stripe is bordered on either side by complete light tan paravertebral stripes, 1 to 2 scales wide at the midbody. A white dorsolateral stripe that is 1½ to 2 scales wide borders each paravertebral tan stripe. There is a grayish to tan midlateral stripe bordered below by a lower lateral white stripe. The dorsal surface of the head is pale bluish posteriorly and grayish anteriorly, where it is tinged with tan. The dorsal surface of the tail is light blue anteriorly grading into pale gray distally. Lateral surfaces of the tail are pale gray to white. Ventrally, the tail is pure white.

Ventral body surfaces are colored with deep blue and pure white. Blue belly patches extend from axilla to groin and are separated on the midline at midbody by 4 to 5 scales. A prominent blue throat patch covers the posterior half of the ventral surface of the head, and is not divided on the midline. All other ventral surfaces are pure white.

Variation. As in *S. u. consobrinus,* females are longer and larger bodied. The largest specimen in the hypodigm is a female measuring 65 mm. snout vent. *S. u. cowlesi* is not significantly different in body size from *S. u. consobrinus.*

Sexual dimorphism is also present in the ventral color pattern. Females have *pale blue* belly patches that are less extensive than those of males. These patches are separated at midbody by a wider white central area, approximately 10 scales wide. The throat patch of the female is pale blue and is less extensive than that of males. It is separated at the midline into two distinct parts. In either sex the dorsal surfaces of the head and legs may have a few small light brown flecks. The numerous dark flecks on the light areas of the body and on all ventral surfaces in *S. u. consobrinus* are entirely lacking in *S. u. cowlesi.*

Dorsal scale counts and femoral pore counts fall within the ranges for *S. u. consobrinus,* from which *S. u. cowlesi* has been derived.

The unique color pattern is the essential characteristic that clearly sets *S. u. cowlesi* apart from all other members of the species. Our assignment of this animal to subspecific rank is considered by us to be tentative. The evolution of the entire White Sands dune fauna is in need of careful study. This small fauna is certainly one of the most unique in North America. It is possible that intrinsic reproductive isolation of White Sands populations from those surrounding the dune mass may be an actuality. If this is the case, the animals are true species. As there are no geographic barriers involved, such a discovery would provide a concrete example of ecological speciation (=sympatric speciation) within the contiguous geographic range of parental stock.

UNIVERSITY OF ARIZONA, TUCSON, and MARINELAND OF THE PACIFIC, MARINELAND, CALIFORNIA

TEMPORARY BIPEDAL LOCOMOTION IN THE LIZARD *AGAMA CAUCASICA* IN IRAQ.—Several lizards of three families are known to exhibit bipedal locomotion when running rapidly (Snyder, Copeia, 1949: 129-137; 1952: 64-70). Other genera of these same families are seemingly quadrupedal at all times. The present note concerns a case of rare bipedalism in a lizard normally quadrupedal.

As a member of the 1954-1955 Iraq-Jarmo Archeological Expedition of the Oriental Institute, University of Chicago, I had the opportunity to observe locomotion in the numerous agamid lizards that lived along the rocky ledges surrounding our camp, at Jarmo, situated in the Chemchemal Valley, in the foothills of the Zagros Mts., eastern Kirkuk Liwa, Iraq. The local agamid, *Agama caucasica* Eichwald, seemingly has the major prerequisites for bipedal locomotion: small front legs, large hind legs, and a long heavy tail (which is, however, round and not bilaterally compressed). Furthermore, although hiding in rocky crevices, the lizard suns and runs in the open, and would seemingly profit from the added efficiency and speed of bipedalism.

The most furious chases, however, failed to result in an observation of bipedalism, although a pursued lizard, being observed from the rear, is not a good subject for study. By placing myself along an eye-height ledge and having someone else chase the lizards past, a perfect view was obtained, but even on the hottest day and during the most rapid rush, I would not observe any bipedalism, and after a month or so I was convinced that such never occurred.

One day, however, chasing one of these lizards with a Jeep (much easier than on foot), the animal came to the base of a small cliff, which I thought it was going to ram head-on. Instead, it rose on its hind legs, took the last five or six steps bipedally, and then leaped up the cliff. The same behavior was later observed on several other occasions.

It is concluded, then, that *Agama caucasica* is normally quadrupedal, but can become bipedal for a few steps when rushing at full speed toward a vertical barrier.

I am grateful to Hyman Marx, of the Chicago Natural History Museum, for the identification of the lizard, on the basis of specimens collected while observing them at Jarmo.—*Charles A. Reed*,[1] *College of Pharmacy, University of Illinois, Chicago, Illinois.*

[1]My work with the Iraq-Jarmo Archeological Expedition was financed by a grant from the National Science Foundation to the Department of Anthropology of the University of Chicago.

Notes on the Food Habits of the Slimy Salamander *Plethodon glutinosus glutinosus*

By JOHN A. DAVIDSON

The food habits of the Slimy Salamander, *Plethodon glutinosus glutinosus* (Green), are still largely unknown. No detailed study has yet appeared. The results of my own investigations on this subject are thus perhaps worthy of record.

Six field trips were made. The first four were to Lake Sherando Park, George Washington National Forest, in the Alleghany Mountains south of Waynesboro, Virginia. The first three of these trips, taken in early August, 1954, yielded 39 salamanders. The fourth trip to Sherando Park, taken in early September, produced but 6 specimens since at this time the area was dry; the lake had been partially drained and the surrounding mountains lacked their usual amount of surface moisture. The latter specimens were found quite deep in the soil, no doubt due to the lack of surface moisture. On the fifth trip, during the last part of September, 1954, to the Great Falls area of the Potomac River on the Maryland side, six more specimens were taken. Finally, three days in early May, 1955, were spent in the Sherando area where fifty more were collected. In all, 101 salamanders of this species were collected.

In the majority of cases, the salamanders were found immediately under stones or decaying logs along streams. Some of the salamanders were found under decaying Virginia pine logs, but most were found under oak or chestnut logs in late stages of decay.

During early summer *Eurycea l. longicauda* (Green) was present in considerable numbers, more under logs than under stones. In order of lesser abundance, *Plethodon c. cinereus* (Green), *Eurycea b. bislineata* (Green), *Desmognathus f. fuscus* (Green), *Pseudotriton r. ruber* (Sonnini), and *Gyrinophylus p. porphyriticus* (Green) were also found.

The most abundant animals found associated with the slimy salamander were ants, particularly plentiful in the valleys of Sherando Park.

All salamanders were immediately placed in 70% alcohol to stop digestion as soon as possible after capture. Concentrations stronger than 70% caused considerable shrinkage to the organs, especially the stomach and its contents.

In dissection a slit was made from the vent to the gular fold. The stomach was detached from the esophagus and removed with all the rest of the alimentary canal, severed at the vent. The enlarged cloacal region was included because many animal fragments, including the elytra of beetles, heads of ants, and segments of millipedes, could be extracted from it.

The results of the food study are given in the following tables.

Availability is probably the most important single factor governing the feeding habits of *Plethodon g. glutinosus*. Table I shows that Hymenoptera contributed most to this salamander's food, constituting nearly half the bulk. Some yellow jackets and wasps were found in the stomachs of the fall collection, but ants made up the greatest percentage of Hymenopterous bulk. Beetles were the second most abundant food item found.

TABLE I

Stomach Contents of 100 Slimy Salamanders (*Plethodon glutinosus glutinosus*).

Food Item	Frequency of Occurrence	Percent by Bulk
Snails	18.0	5.00
Sowbugs	1.0	1.00
Earthworms	6.0	3.80
Centipedes	9.0	5.40
Millipedes	13.0	7.20
Arachnids	11.0	3.35
Phalangids	1.0	.05
Pseudoscorpions	3.0	2.05
Roach (Cryptocercus)	1.0	.40
Homoptera	2.0	.15
Hemiptera	1.0	.30
Diptera	8.0	2.65
Lepidopterous larvae	1.0	.60
Coleoptera	43.0	17.90
Coleopterous larvae	15.0	8.40
Hymenoptera	73.0	41.75

TABLE II

The Seasonal Relationship of Stomach Contents Expressed by Frequency of Occurrence and by Percent of Total Bulk.

	Spring Collection (50 salamanders)		Fall Collection (50 salamanders)	
Food Item	Frequency of Occurrence	Percent by Bulk	Frequency of Occurrence	Percent by Bulk
Snails	20.0	4.0	16.0	6.0
Sowbugs	2.0	2.0	0.0	0.0
Earthworms	12.0	7.6	0.0	0.0
Centipedes	16.0	9.8	2.0	1.0
Millipedes	16.0	7.4	10.0	7.0
Arachnids	10.0	2.9	12.0	3.8
Phalangids	0.0	0.0	2.0	0.1
Pseudoscorpions	0.0	0.0	6.0	4.0
Roach (Cryptocercus sp.)	0.0	0.0	2.0	0.8
Homoptera	0.0	0.0	4.0	0.3
Hemiptera	0.0	0.0	2.0	0.6
Diptera	6.0	2.0	10.0	3.3
Lepidopterous larvae	0.0	0.0	2.0	1.2
Coleoptera	30.0	13.0	56.0	22.8
Coleopterous larvae	6.0	4.2	24.0	12.6
Hymenoptera	72.0	47.1	74.0	36.4

A check on the *Coleopterous* families showed that Carabids were most frequently eaten. Elaterids, Pselaphids, Scarabs, Staphylinids, Curculionids, Nitidulids, Meloids, Tenebrionids, Ostomids, and Lagriids followed in order of decreasing abundance.

The factor of availability is further shown in the seasonal relationship, Table II. Here it is seen that in the moist spring months sowbugs and earthworms were eaten. In the fall season they were not found. The converse was true for Phalangids, Pseudoscorpions, Roaches, Homopterans, Hemipterans and Lepidopterous larvae.

The largest single animal eaten was a centipede measuring 45 mm. In another stomach, ten Buprestid larvae were found.

Only one slimy salamander was found with an empty stomach. This specimen was not included in the food tables.

WASHINGTON MISSIONARY COLLEGE, TAKOMA PARK, MARYLAND

A CASE OF POSSIBLE OVERWINTERING OF *TERRAPENE O. ORNATA* IN A WELL.—On March 8, 1953, three ornate box turtles, *Terrapene o. ornata* Agassiz, were discovered in an old well situated in a pasture one mile east and one mile south of Melvern, Osage County, Kansas. The water level in the well was about five feet below the surface of the ground. The depth of the water was one and one-half feet, and the temperature was 45° F.

Two of the turtles were floating on the surface of the water with their heads and legs extended and dangling, as if dead. When prodded with a stick, however, they slowly withdrew the limb that was touched. The other turtle was lying on the bottom, its head and legs drawn into the shell. The turtles were secured and placed in a warm basement, where all began actively moving about within a short while.

There had been no prolonged warm spells during the previous winter months that would have induced these turtles to emerge from a more prosaic hibernating site and wander about, subsequently entering the well. Therefore, they probably entered the well the previous fall, presumably by accident, since a well is so different from the usual hibernating site of the species. The well was particularly suitable for accidental entry, for the open top was even with the ground level, with no curbing or cover present. During the subsequent two winters, the well was checked and no turtles were found.

T. o. ornata normally hibernates by burrowing into loose soil or beneath piles of leaves or other surface litter. It is of interest, therefore, to note this particular instance when three of the turtles were found in an aquatic situation, presumably having spent the winter there.—*Robert F. Clarke, Department of Biology, Kansas State Teachers' College of Emporia.*

THE DISTRIBUTION OF *RANA SYLVATICA CANTABRIGENSIS* BAIRD IN WESTERN CANADA AND ALASKA.—In view of the paucity of published collection records for the Northern wood frog in Alaska and Western Canada, a small collection in the Oregon State College Museum of Natural History appears worthy of mention, since the specimens represent rather significant extensions of the known range of the species.

A male (OSCMNH 2748) was collected by William Kunkel, August 25, 1952, near Tustemena Lake on the western side of Kenai Peninsula, Alaska. The only habitat data given are "in tall grass near the lake." As near as I am able to ascertain, the wood frog has not previously been reported in this region, the nearest being Cope's record at Aleknagic Lake=(Alloknagic Lake) (1886, Proc. Amer. Phil. Soc., 23: 520), on the mainland, nearly 300 miles to the west and separated from Kenai Peninsula by Cook Inlet. Loomis and Jones (1953, Herpetologica, 9: 149) have recorded the species 15 mi. SE Northway and 25 mi. S, 20 mi. E Fairbanks, also over 300 miles airline distance from the Tustemena Lake locality. Another specimen (OSCMNH 8279) was collected June 25, 1952, by G. M. Daetz along the bank of the Kuskokwim River near McGrath, Alaska, which is approximately 250 miles NW of Tustemena Lake. No habitat data were recorded.

On July 17, 1955, the author collected four *Rana sylvatica* (OSCMNH 3411-3414) from a small lake located about 0.5 mi. E of Kootenay Crossing on Canadian Highway 1B, Kootenay Nat. Park, British Columbia, Canada. In addition to the wood frogs, three *Bufo boreas* Baird and Girard, two *Rana pretiosa* Baird and Girard and six *Ambystoma macrodactylum* Baird were taken in the vicinity of the lake. All the wood frogs were discovered several feet back from the edge of the lake, whereas the *R. pretiosa* were found at the edge of the water which they hastily entered when disturbed. The vegetation adjacent to the lake consists of lodgepole pine (*Pinus contorta*), aspen (*Populus tremuloides*), spruce (*Picea engelmanni*) and willow (*Salix sp.*), with grasses and sedges along one margin, the other being exposed gravel. This appears to be the first record of *R. s. cantabrigensis* west of the Continental Divide in SE British Columbia and the first instance where the species has been reported from the drainage basin of the Columbia River.

Another *R. sylvatica*, along with three *Ambystoma macrodactylum*, was collected July 17, 1955, near a small lake located approximately 11 mi. E of Eisenhower Fork on Canadian Highway 1, Banff National Park, Alberta, Canada. At this place the elevation is roughly 4500 feet and the vegetation similar to that mentioned above.—*Denzel E. Ferguson, Department of Zoology, Oregon State College, Corvallis, Oregon.*

The Relationships of the Yosemite and Western Toads

By DON P. MULLALLY

This paper is concerned with the dissimilarities of the Yosemite Toad (*Bufo canorus* Camp) and the Western Toad (*Bufo boreas halophilus* Baird and Girard) and their possible significance in analysis of relationships of the two species. Both toads occur in the central Sierra Nevada Mountains of California, but are physiographically isolated from each other. The Yosemite Toad occupies the Canadian, Hudsonian, and Lower Arctic-alpine Zones at general elevations of 6,500 to 11,000 feet, but it is most common above 9,000 feet. On the western slope of the Sierras in Yosemite National Park, the Western Toad seems to occur rarely higher than the Lower Transition Zone at an elevation near 4,000 feet (Grinnell and Storer, 1924, Animal Life in the Yosemite: 655). Thus these species are isolated from each other by at least 2,000 feet of elevation, and it is my belief that a gap of 3,000 to 4,000 feet is more prevalent. It is reasonable to expect that such vitally different environments have fostered the establishment in each species of a number of important specific physiological adjustments. These may include embryonic temperature adaptations as worked out for certain eastern species of anurans by Moore (1942, Biol. Symp., 6: 189-213) and Volpe (1953, Phys. Zool., 26: 344-355).

The two species are rather similar in many respects and have seemed to be so closely related that it has been suggested that the Yosemite Toad is a high-altitude differentiate of the Western Toad (Stebbins, 1951, Amphs. Western N. Amer.: 245). The morphology of the Yosemite Toad is sufficiently distinctive to warrant classification of the animal as a separate species (Camp, 1916, Univ. Calif. Publ. Zool., 17: 11-14). Two outstanding physical characters are that *Bufo canorus* is much smaller than all subspecies of *Bufo boreas* except *exsul*, and *canorus* is the most sexually dimorphic toad in the United States. Though the tadpoles of the Yosemite and Western toads are fairly similar (Stebbins, *op. cit.*: 247), recent extensive work by Karlstrom and Livesey (1955, Herpetologica, 12: 221-227) has made evident some striking dissimilarities between the two in the embryonic and larval stages. The tadpoles have differences in size, shape, proportions, and coloration. The eggs of the two species are surprisingly different, eggs being separated by partitions in *canorus* and not in *boreas*, ova of larger *boreas* being smaller, ova being in single or double rows in *boreas* and only single in *canorus*, and eggs of *boreas* being in long strings and of *canorus* in short strings and/or clusters. As Moore (*op. cit.*: 197) has shown, egg clustering in itself is one type of anuran embryonic adaptation to a cold climate.

Other differences between the Yosemite and Western toads are known which have not been mentioned in the above references (Mullally, 1952 Copeia: 274-276, and 1953: 182-183; Mullally and Cunningham, 1956, Herpetologica, in press). These differences largely concern habits and habitat preferences, factors that would seem to be at least as important to their survival as small anatomical variations. The adult Yosemite Toad

is primarily diurnal and only occasionally may be found active under crepuscular conditions. However, at least in the area around Los Angeles and Big Bear Lake, California, the Western Toad is primarily crepuscular and nocturnal and is found active in the daytime only under unusual conditions. Length of time in the larval stage probably constitutes another difference. Since *canorus* tadpoles are present in breeding waters in very immature stages of development up to at least mid-September, or within several weeks of the onset of cold weather, it seems quite likely that many winter over before metamorphosing. These observations apply to elevations of 9,500 to 11,000 feet. It is known that the tadpoles of another anuran of the same high elevations, *Rana boylei sierrae* Camp, also winter over (Grinnell and Storer, *op. cit.*: 665). *Bufo boreas halophilus* metamorphoses in one season. To continue, *canorus* is mostly restricted to the margins of bodies of water and to moist, luxuriantly vegetated meadows, but a few occur in dry meadows with sparse grasses and sedges not more than a few hundred feet from water or moister ground. *B. boreas*, on the other hand, usually frequents water only during the breeding season or in time of dry weather to regain body moisture. It normally occurs up to thousands of feet from water in comparatively dry situations including cultivated fields, grassland, sagebrush, and forest floor. Related to this distribution, *boreas* has also been noted to travel widely at night (Pimentel, 1955, Herpetologica, 12: 72), whereas observation on *canorus* indicates that it spends its hours of activity within a space of only a few yards.

The above survey probably only begins to list the differences between the two species. Their significance along evolutionary, phylogenetic, and ecological lines remains to be determined. However, one other difference may be present which would be of considerable value in making future decisions. This refers to the mating song of male *Bufo canorus*. As described by Grinnell and Storer (*op. cit.*: 659), "The mating song of the Yosemite Toad is a sustained series of ten to twenty or more rapidly uttered notes, constituting a "trill," and the whole song is repeated at frequent intervals. When a number of males are giving their songs in the same place, the songs overlap one another so that the general chorus is continuous." To the authors knowledge, excepting other characteristics of the voice, this constitutes all that is published concerning the mating song. The description implies that the males vocalize while separate and untouched by other toads, either in exuberance or for the purposes of marking territories, exciting females, or directing them to breeding areas. If the song is undertaken under these conditions and for any of the purposes stated, it is substantially different from the vocalizing of *Bufo boreas halophilus*: during breeding, male Western Toads vocalize only when other toads grasp their backs, sides, and groins as if to assume the dorsal position of amplexus. This stimulus causes the bottom male to give a few chirps, whereupon the top male releases its hold and departs to similarly test other nearby toads in its search for a female. The females are silent, among other differences, and males retain their clasp upon them. The important fact is that separate and untouched males do not chorus. Provocation through contact with other animals is necessary to induce song. Apparently none of the inferences stated for *canorus* hold for *boreas*.

Karlstrom and Livesey (*op. cit.* :227) state that the eggs of *canorus* most closely resemble those of *Bufo cognatus* say, not *Bufo boreas*. If the breeding song of *canorus* is also unlike that of *boreas* in the way described above but is given in chorus by unmolested males, as in *cognatus* and many other eastern species of toads, further doubt is forthcoming as to the derivation of *canorus*. At least evolution will be shown to have progressed in unsuspected directions. If, on the other hand, the song proves to be a derivative of the *boreas* type, the prevalent belief in the close relationship of the Yosemite and Western Toads will be significantly strengthened.

SAN MATEO COUNTY JUNIOR MUSEUM,
SAN MATEO, CALIFORNIA

A SHREW EATEN BY A KING SNAKE, *LAMPROPELTIS C. CALLIGASTER* (HARLAN).—Many authors record mice and other small rodents, birds and lizards as articles of sustenance for the Yellow-bellied King Snake, but not shrews. The following incident is accordingly of interest. Immediately after capture of one of these snakes in the Lake Murray region of Ardmore, Oklahoma, a shorttail shrew (*Blarina brevicauda*) was dropped in the cloth bag with the snake. Later the shrew was found dead from unknown cause. It was left with the snake, but when re-examined fifteen minutes later the snake had eaten it.

The observation here reported, coupled with the obvious abundance of *Blarina* in this particular area (with seemingly fewer rodents), suggests that the shrew may actually be a common article of diet for *Lampropeltis c. calligaster,* at least in the Lake Murray area, although comparatively few snakes have ever been reported to eat them. Schmidt and Davis (1941, Field Book of Snakes: 219, 285, 302) noted only three such records. The absence of previous records is puzzling, but may be due to several factors: (1) observers may not always distinguish shrews from mice; (2) snakes normally may find more rodents and other prey than insectivores; or (3) the pungent odor produced by shrews may protect them from would-be predators that, like some snakes, rely almost wholly on the sense of smell in choice of food.—Gary W. Kern, 417 Newcomb St., S.E., Washington 20, D.C.

DISTRIBUTION OF THE WOOD TURTLE, *CLEMMYS INSCULPTA*, IN MARYLAND.—The Wood Turtle has been found quite frequently in the four westernmost counties of Maryland, namely, Garrett, Allegany, Washington and Frederick. More eastern records for this turtle in Maryland are scattered. McCauley (in "Reptiles of Maryland," 1945: 155) cites specimens from along the Potomac River as far south as Cabin John and Plummers Island, in Montgomery County, Maryland. No doubt these specimens had come down the Potomac from the mountainous counties mentioned above. McCauley cites specimens from along the Susquehanna River at Havre de Grace; these presumably are also waifs carried down the Susquehanna from the mountainous regions of Pennsylvania where this turtle is more abundant. Specimens I have collected in the Broad Creek area in northern Harford County are of importance as a link between the Pennsylvania specimens and those found at Havre de Grace (USNM 14582) and on Roberts Island (cited in McCauley).

Between the Potomac and Susquehanna Rivers are several large rivers (Patapsco, Big Gunpowder, Little Gunpowder, Broad Creek) coming down from the Piedmont area to the Chesapeake Bay. Three records from near these rivers are available in Baltimore County: south of Liberty Dam on the Patapsco River (one specimen, C. F. Reed); Notch Cliff Road at the Big Gunpowder River (one specimen, C. F. Reed, June 15, 1955); and White Marsh, a locality just east of and below the Fall Line and just south of the Big Gunpowder River (Surface, 1908). From these records it seems likely that the Wood Turtle gets down most of the large mountainous and Piedmont rivers in Maryland as far as the Coastal Plain.

The record from White Marsh reported by Surface is somewhat discounted by McCauley on the basis that the specimen was seen in the water eating the flower buds of water lilies in ponds. Due to the more terrestrial habits assigned to this turtle, alluded by the name "Wood Turtle," McCauley leaves the matter obscured by stating that the specimen was probably not the Wood Turtle, and that the description of the specimen was too indefinite to refer to any other turtle with certainty.

From my own experience in collecting the Wood Turtle in Maryland, I have invariably found it in or very near water. In Allegany County I collected this turtle swimming in Fifteen Mile Creek; in Frederick County, in the Catoctin Mountains, I collected it in a spring; in Baltimore County it was very near the Big Gunpowder River (about 20 feet away), and at Liberty Dam it was along the Patapsco River. I have never found the Wood Turtle in what I would call a truly terrestrial habitat, that is, in a woods.

One other record for the Wood Turtle in Maryland seems very interesting. It is a record from the Eastern Shore, from near Easton in Talbot County. This specimen was collected at night crossing the road (see McCauley, *loc. cit.*). Again, McCauley questionably discounts the specimen as a probable escape in that region. However, the region about Easton, Wye Mills and Longwoods in Talbot County is a very interesting one from an ecological point of view. Many plants are known off the Piedmont Plateau only in this one Coastal region of the Eastern Shore. From the number of Piedmont species of plants which I have found in this region, I am sure that the Wood Turtle and perhaps other animals are here because of natural distribution.—Clyde F. Reed, 10105 Harford Road, Baltimore 34, Maryland.

Please paste this over page 136 of part 2, which was a duplication through error of the article published on p.80 of part 1. This correction is made without expense to the H.L.

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SALT LAKE CITY

NORTHERN EXTENSION OF KNOWN RANGE OF THE FLORIDA FIVE-LINED SKINK IN VIRGINIA.—While collecting reptiles and amphibians on the peninsula of Virginia between the Rappahannock and Potomac Rivers, more frequently called Northern Neck, the author caught a specimen of the Florida Five-lined Skink, *Eumeces inexpectatus* Taylor. The specimen was found one mile north of Heathsville, near Clark's Mill, Northumberland County, Virginia, May 15, 1954, under a log, in a semi-dormant state, as it could be picked up easily and did not attempt to escape. Identification of the specimen has been verified by Walter Newman and the specimen is No. 854 in the herpetological collection of the author.

Hoffman (1953, Herpetologica 8: 172-173) gives records for *Eumeces inexpectatus* in Virginia from the following counties: Princess Anne, Isle of Wight, Norfolk, Namsemond, Southampton, James City, New Kent, Nottoway and King & Queen (the northernmost locality in Virginia). Hoffman states that "I do not doubt that it occurs at least as far as the Potomac estuary". Hoffman had previously reported (1945, Proc. Biol. Soc. Wash. 58:131-132) this species from Alleghany County, Virginia, but he later concluded that this specimen is different from typical *E. inexpectatus* and did not include that county in the 1953 paper.

While discussing "Some problems on Eumeces in Maryland" (1939, Bull. Nat. Hist. Soc. Md. 9: 59-62), McClellan stated "*inexpectatus* has not yet been recorded as far north as the Potomac." He gives only Norfolk County for Virginia. Smith (1946, Handbook of Lizards: 351, map 28) indicated on his map that this lizard had been found in Virginia up to the Rappahannock, but not on Northern Neck. In the text he indicates that the species ranges up to southern Virginia.

Therefore, the specimen at hand extends and establishes the range of the Florida Five-lined Skink north to the Potomac River. Clark's Mill is only a few miles from the Potomac, between Heathsville and the river. Natives of the region state that this lizard is very common there and they call it a scorpion, a name applied to nearly any species of *Eumeces* in that region. Incidently, *E. fasciatus* is very common here and *E. laticeps* less common. Records of all these lizards will appear shortly in the Herpetofauna of Northern Neck.

It may be of interest to note that several species of plants also reach their northernmost range on Northern Neck, one of the most outstanding being the evergreen species of wild ginger, *Asarum virginicum,* called heartleaves.—*Clyde F. Reed, 10105 Harford Rd., Baltimore 34, Md.*

A Disjunct Population of the Long-nosed Salamander From the Coast of California

By R. W. Russell and James D. Anderson

Mid-coastal California, although heavily populated and thoroughly explored by zoologists, continues to yield occasional herpetological surprises. Only recently such well-defined new subspecies as *Masticophis lateralis euryxanthus* (Riemer, 1954), *Thamnophis elegans aquaticus* (Fox, 1951), *T. e. terrestris* (Fox, 1951), *Ensatina eschscholtzi xanthoptica* (Stebbins, 1949), *Aneides flavipunctatus niger* (Myers and Maslin, 1948) and *Eumeces gilberti cancellosus* (Rodgers and Fitch, 1947) have been described from the vicinity of San Francisco Bay and its surrounding mountain ranges. The present addition to this list represents an isolated population of a boreal (*sensu* Miller, 1951, Univ. Calif. Publ. Zool., 50 (6): 582-591) salamander nearly four hundred miles south of its recognized coastal range and one hundred and fifty miles southwest of the nearest Sierra Nevada populations, from which it is separated by the Great Central Valley of California.

Ambystoma macrodactylum croceum, new subspecies

Diagnosis. An *Ambystoma macrodactylum* (Fig. 1) differing from the nominate form, *A. m. macrodactylum* Baird, as follows: (1) Color of dorsal markings dull orange (Plate 13, shade 10H and vicinity, Maerz and Paul, 1950; between Pekinese and Raw Sierra, Ridgway, 1912);* (2) dorsal band broken into a series of discrete, irregular patches; and (3) dorsal head pattern greatly reduced, consisting of small scattered dots, which are often absent anterior to the eyes.

Holotype. Adult male, No. 63734, Museum of Vertebrate Zoology, collected by Anderson and Russell, December 2, 1954, at Rio Del Mar, Santa Cruz County, California.

Description of Holotype (from living anesthetized animal). Length from snout to anterior margin of vent, 57.2 mm; from vent to tip of tail, 51.0 mm; head width, 9.5 mm; head length, 13.9 mm; vomerine teeth, 33, in four groups (6, 9, 11, 7) forming a transverse arc behind the internal nares; costal grooves 13, counting one each in axilla and groin.

Ground color black, consisting of heavily concentrated melanophores; pattern on the back a series of eleven small orange patches; this light pigment represented by tiny dots on head and a nearly continuous stripe along crest of tail; guanophores absent dorsally, concentrated as a band of silvery flecks dorsolaterally along a line connecting the limb insertions and extending forward onto the upper surfaces of cheeks and forelimbs; guanophores fewer on hind limbs and lateral surfaces of tail, widely scattered on belly; upper half of eye with a guanoid patch given a pinkish cast by associated blood vessels; this eye color lost after preservation.

*Mr. Denzel Ferguson of Oregon State College, who has had considerable field experience with the nominate race, pointed out to us the diagnostic value of this character.

VARIATION

Dorsal Coloration. In 22 metamorphosed individuals from the type locality, the shade of the dorsal light markings is the least variable of the diagnostic characters. One adult male shows definite melanistic tendencies, apparently lacking dermal guanophores and having the orange patches darkened by the reduction of their brightest and most superficial pigmentary element. Nine adults show virtually the same orange shade as the type, and 12 juveniles are but slightly paler. In all the animals, the ground color is deep, lustrous black.

Dorsal Pattern. In 6 (28 percent) of the paratypes, there are fewer than 4 transverse breaks in the continuity of the light dorsal pattern between the neck and hind limb insertions, producing a definitely striped, rather than spotted aspect. These specimens differ from 76 percent of the *A. m. macrodactylum* examined by us (153 specimens, from localities widely distributed over its range) in having the stripe interrupted at least once. In the remainder of the paratypes, 6-14 transverse breaks divide the pattern into 9-24 discrete patches, these counts excluding markings lying below the upper ends of the costal grooves, and breaks that slant across the vertebral axis at angles of more or less than 85-95 degrees.

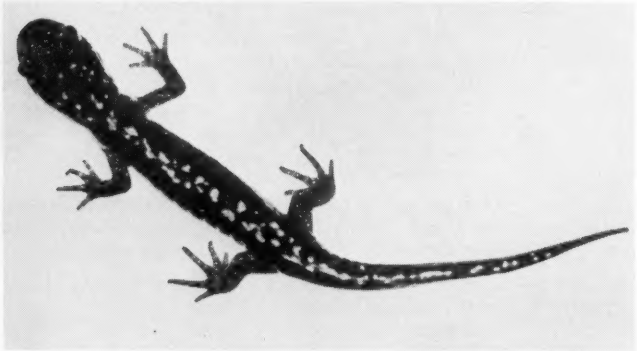


Fig. 1. *Ambystoma macrodactylum croceum*, paratype, snout-vent length 33 mm.

Only three (2 percent) of the available *A. m. macrodactylum* show break (8-10) and patch (12-24) counts comparable to those of the majority of *A. m. croceum*. These individuals are all from Crater Lake, Oregon.

Head Pattern. As a rule, the light pattern on the head and snout of *Ambystoma macrodactylum* is fragmentary, but extensive in area. Reduction of the head pattern to speckling appears occasionally (4 per cent) in the *A. m. macrodactylum* examined by us (153 specimens) but in no series are the markings so poorly developed as in *A. m. croceum*. In 10 paratypes orange pigmentation is macroscopically evident on the snout, forming round spots both smaller and more scattered than those of any

of the typical race examined. Behind the eyes, all the *croceum* available are dotted with orange.

HABITAT

The paratypical specimens were all taken at night on or near Bonita Road, a sandy street skirting the south shore of Valencia Lagoon as designated on the Capitola quadrangle of the U.S.G.S. topographical map series. The north-facing slope overlooking the lagoon is densely clothed with humid oak forest. Across California State Highway No. 1, the south-facing slope presents a grassy-herbaceous aspect. Less than a mile to the northwest in the valley of Valencia Creek, an apparently native stand of redwood (*Sequoiadendron sempervirens*) occurs.

Presumably *A. m. croceum* is an inhabitant of the oak forest south and west of Valencia Lagoon, repairing to this body of water to breed. The terrestrial habitat is sharply demarcated at the top and bottom of the slope, grassland and scattered bushes of *Baccharis pilularis* bordering it in each instance, with little or no ecotonal development. The overwhelming stand dominant is *Quercus agrifolia,* which species constitutes about ninety percent of the forest crown. Madrone (*Arbutus menziesii*) is sparingly represented in this stratum, and Douglas fir (*Pseudotsuga menziesii*) is extremely sparse. *Lithocarpus densiflora* and *Umbellularia californica,* commonly occurring with oak in central California's fog belt hardwood situations (Howell, 1949) appear to be absent. The sandy nature of the subsoil may be partly responsible for this.

The great density of the shrub and herb strata is indicative of higher humidity in this stand than is evidenced by the species composition of its canopy. *Corylus rostrata* and *Rhamnus californica* are the obvious shrubby dominants. Secondary in importance in this layer are *Ribes sanguineum* and *Ceanothus thyrsiflorus,* while *Sambucus sp.* and *Arctostaphylos sp.* assume but incidental roles. On artificial openings and along the lower border of the forest, *Baccharis pilularis* is a conspicuous shrub.

The lowest stratum of the habitat consists largely of dense *Rubus* tangles except in the deepest shade where the ground is nearly bare of living plants. Poison oak (*Rhus diversiloba*) is also abundant, growing in large clumps where the light is best. A large fern of the genus *Polystichum* also occurs commonly in clumps, and bracken fern (*Pteridium aquilinum*) while frequent is not truly a dominant plant.

Valencia Lagoon itself is a large temporary pond. At its maximum surface extent, it measures approximately 30 yards wide at the widest point, and 175 yards long. A distinct zonation of emergent vegetation is evident at all seasons, the central portion (where maximum water depth approaches 30 inches) being occupied by disjoined patches of *Typha,* while the shallows of the east and south shores support a dense, nearly continuous mat of *Polygonum sp.* In the dry seasons of 1953 and 1954, at least, no living aquatic plants were observed, nor has surface water been present. The drainage of the "lagoon" is to the west, into Valencia Creek by way of an intermittent tributary.

Hyla regilla Baird and Girard and *Rana aurora* Baird and Girard seem to be the only amphibians which use this pond as a breeding site. *Taricha torosa* (Rathke), although abundant elsewhere in Santa Cruz

County, appears to be absent from the Valencia Lagoon fauna. The surrounding oak forest habitat is shared with *Ensatina eschscholtzi* Gray, *Aneides lugubris* (Hallowell) and *Batrachoseps attenuatus* (Eschscholtz).

As yet, we have found the new form only at the type locality, although other apparently suitable habitats exist nearby, as at Corralitos Lagoon, and at other unnamed cat-tail marshes in the vicinity.

DISCUSSION

Our use of a trinomial for this salamander, in the face of its geographic isolation from *Ambystoma m. macrodactylum*, is justifiable on anatomical grounds. The body proportions and meristic characters of the paratypes fall within the ranges given by Mittleman (1948, Herpetologica, 4: 81-95) for the species as a whole.

As far as can be determined from limited available material, the affinities of the new race are with southern Oregon, and possibly with Sierra Nevada, populations. As indicated above, certain Crater Lake examples show identical disruption of the dorsal pattern. In Sierran material there is a tendency toward disruption also, in that deep lateral indentation of the band is common, but actual transverse breaks in its continuity are few. In intensity of the black hue of the dorsal ground color, *croceum* is matched by live specimens from Cascade and Sierra localities in California, but individuals from the vicinity of Corvallis, Oregon, kindly supplied by Dr. R. M. Storm, exhibit a much paler ground color.

ACKNOWLEDGMENTS

Mr. Joseph R. Slevin of the California Academy of Sciences has made specimens available to us. We wish to thank Dr. Robert C. Stebbins for critical reading of the manuscript and many useful comments. Dr. Robert Storm and Mr. Denzel Ferguson of Oregon State College generously provided information on the nominate race and sent us living material for comparison.

MUSEUM OF VERTEBRATE ZOOLOGY, UNIVERSITY
OF CALIFORNIA, BERKELEY

RANGE EXTENSION OF THE WHIPTAILED LIZARD IN OREGON.—On June 23, 1954, while on a collecting trip near the John Day River, three *Cnemidophorus tigris* Baird and Girard were seen, and two collected at a point known as Turtle Cove, approximately 10 miles south of Kimberly, Grant County, Oregon, along Oregon Route 19. Three more of this species were seen in the same area in late July. This record represents a range extension north and west of 60 miles or so.

The soil in this area is loose and coarse and supports a fairly heavy growth of sagebrush. All whiptails were on a level area at the base of steep hills or on the north side of a small arroyo dissecting the hills.

Associated reptiles were *Uta stansburiana* Baird and Girard, and *Pituophis catenifer* Blainville.

Identification of specimens was checked by the Oregon State College Museum of Natural History, and this note by Dr. Robert C. Stebbins.—Eric Skov, 6265 S.E. Stark St., Portland 16, Oregon.

Defensive Behavior and Effects of Toxins in *Bufo alvarius*

By JOE A. HANSON and JAMES L. VIAL

In the twenty-five years that have passed since the original report of Musgrave and Cochran (1930) on the toxic effects of *Bufo alvarius* Girard, much speculation and controversy has developed about the poisonous qualities and defensive attributes of these toads. Musgrave (*op. cit.*) reported his observations on the lethal effects of such toxins upon a dog, and also described those of lesser severity upon himself. He held the opinion that the toxins were either volatile or emitted in a fine spray from the cutaneous glands. Cochran (*op. cit.*), however, stated that she had been unable to determine any such symptoms from handling these toads in captivity. As a result of the interest stimulated by this report, the chemical nature of the granular gland secretions and the physiological action of isolated constituents obtained from *B. alvarius* were clinically studied by Chen and Chen (1933, 1934). Stebbins (1951) includes in his account of this species the observations of Hendrickson in describing the toxic effects of one of these toads upon a bulldog. As the latter author has implied, the cursory published reports and unpublished observations of the natural occurrence of these phenomena are inadequately supported by scientific investigations.

The actual beginnings of the present paper arose when the writers were concerned with the marking of individual specimens of *B. alvarius* for identification in studying reproductive behavior. Upon slightly squeezing one of the parotoid glands between the fingers, a milky substance was ejected for a considerable distance. Presumably, if such secretions could be ejected by the toads themselves, an important defense mechanism might be present in this species. It was with this consideration in mind that the present phase of investigation was developed.

The purpose of the studies presented here has been to determine the extent of the natural utilization of such toxins as are apparently available to *B. alvarius*, the effectiveness of these toxins as a defense mechanism and the possible volatile qualities the toxins might possess. The experiments were conducted in the laboratories of the Department of Zoology, University of California at Los Angeles, under the direction of Professor Raymond B. Cowles. The authors gratefully wish to acknowledge the generous enthusiasm and valuable suggestions offered by Dr. Cowles, without which this study could not have been accomplished.

The experiments included testing for the amounts and distances of forcible ejection by manipulated pressure on the parotoid, femoral, tibial and humeral glands. The volatility of the toxins was tested by utilizing a specially constructed chamber through which air and gaseous inclusions could be passed in the presence of the test animal. In this procedure the tests were conducted with *Mephitis mephitis* (Striped skunk), *Felis domestica* (Domestic cat) and *Canis familiaris* (Domestic dog). The actual defensive behavior of *B. alvarius* was most successfully demonstrated in experiments with *M. mephitis* and the effects of the toxins were observed in experiments with *M. mephitis* and *Canis familiaris*.

PROCEDURE AND RESULTS

The ejections of toxins from the granular glands of *B. alvarius* were obtained only by exerting manual pressure upon them. The range of the discharges obtained from the parotoid glands varied in distance from approximately one foot to twelve feet (average six and one-half feet). The distances covered by the discharges were not reduced after repeated ejections from the same gland, the final ejection from a given gland demonstrating an equal possibility of obtaining the maximum distance as the first. This is most probably the result of the particular structure of the granular glands, as described by Muhse (1909) and Noble (1931). These glands are shown to be a composite of smaller glands, each an entity in itself and possessing its own duct opening to the surface. As many as sixteen discharges were obtained from a single parotoid gland of one adult female toad. The maximum number of ejections obtained from other granular glands was significantly less (humeral—4, femoral—9, and tibial—6). The distances obtained from the ejections of these latter glands were also considerably less, with a maximum of approximately four feet. The general appearance of the gland structure was much the same before and after the ejections; however, the punctated nature of the glands was slightly more obvious after the ejections.

The number of ejections can be correlated with the relative size of the glands. The secretory droplets were milky in appearance and rather viscous, and became more viscous after exposure to the atmosphere. On several occasions the actual ejections were accompanied by varying amounts of a highly viscous secretion appearing at the surface of the gland, especially in the case of the parotoids. The writers are aware that differential pressures and trajectory can alter both the number and distances of the ejections, and these factors were controlled as carefully as practicable. Under similar conditions *Bufo boreas halophilus* Baird and Girard displayed only a slight ejection, most of the secretions appearing at the gland surface of the parotoids and *Bufo woodhousii* Girard exhibited similar ejections from the parotoid glands. In the latter two species the secretions appeared to be much less viscous than those of *B. alvarius*.

In testing the possible volatile qualities of the toxic secretions of *B. alvarius* a small chamber was constructed in which the test animal could be enclosed and any volatile substances present in the secretions of the toad could be passed through the chamber. The chamber measured six inches in width, twenty-four inches in length and six inches in height. The sides and top were covered with quarter-inch hardware cloth and overlaid with transparent sheet acetate. The two ends of the enclosure limited the movement of the test animal. One end was hinged to serve as a door and was perforated to allow for the insertion of a piece of quarter-inch glass tubing, to which a vacuum tube was attached. The opposite end of the chamber was stationary and perforated by numerous holes which permitted the free passage of air. These holes were covered with a light gauze cloth to prevent any secretions from passing directly into the chamber. An acetate cone was attached to the chamber opposite the end at which the vacuum tube was connected. The truncated apex of this cone afforded an opening one inch in diameter and the base was matched and sealed to the end of the chamber. All joints and openings

other than the open end of the cone, the perforations in the stationary end and the glass tube passing through the door were carefully sealed and tested for air tightness before each experiment. The vacuum tube was attached to the glass tubing and ensured the draft of air from one end of the chamber to the other. This draft was tested before each experiment by observing a slight amount of smoke being drawn from the opening of the cone into the chamber. In each case the test animal was left in the chamber with the vacuum turned on long enough for it to assume a resting manner before the experiment was initiated. With the draft of air established, the parotoid secretions from an adult toad were forcibly ejected from the gland into the cone. Observations were then continued for thirty minutes on the behavior of the animal.

Three animals were subjected to volatility tests in the chamber. *M. mephitis* showed only a brief response to the experiment at the moment of introduction of the parotoid secretions, as the skunk actively sniffed at the end of the chamber to which the cone was attached. Throughout the period of observation the activity of the skunk was to all appearances normal. Respiration was normal and regular and responses to outside actions of the observers indicated the usual alertness of behavior. There was no overt indication of any toxic effects. This experiment was repeated in a slightly different manner. The parotoid secretions of *B. alvarius* were ejected onto a small piece of moist gauze, which was immediately placed within the cone and the forced draft continued. No responses to the toxins could be determined. *Felis domestica* demonstrated no response to the same manner of experimentation first described. Variations in the respiratory rate ranged from seventy, after introduction to the chamber, to one hundred and forty. The writers believe this to be the result of claustrophobic reactions on the part of the cat rather than any effect of the secretions. *Canis familiaris* displayed a similar lack of reaction upon exposure to identical experimental conditions, with no detectable difference in respiratory rates.

The obvious lack of effective volatile toxins in the ejected substances being recognized, experiments were continued in testing the toxic effects of glandular secretions actually ingested by certain animals. Although several investigations of a thorough, precise and technical nature have been done with isolated substances from these secretions in other species of *Bufo* (Abel and Macht, 1912; Chen and Chen, 1933, 1934) and with substances diluted and injected intravenously, nothing has been done under any conditions approaching those in the natural environment or with *B. alvarius* itself. Since the toads possess no means of actually injecting these toxins, the following experiments were carried out in an attempt to simulate natural conditions (*e. g.* as when an animal might be annoying or attacking a toad).

A three-month-old mongrel pup was secured from the UCLA Medical School Vivarium for use in this experiment. The procedure was simply the forcible discharge of the substances from the parotoid glands of *B. alvarius* into the open mouth of the dog. The following results are considered by the authors to be worthy of inclusion in the body of this report.

At 1320 the toad poison was forcibly ejected into the mouth of the dog. There was an almost immediate response by the dog in noticeable frothing and a violent shaking of the head.

1321 The amount of frothing has increased and there is continued violent shaking of the head, as if in an attempt to reject the secretions.

1322 The profuse flow of saliva continues, accompanied by a slight convulsive action in the abdominal region.

1323 Heavy breathing is obvious and there is continued profuse frothing. The coordination of the dog is extremely poor and although it can stand, walking is difficult and awkward.

1324 Coordination, especially in the hind quarters, has become noticably poorer. Apparent loss of bladder control is indicated by great discharge of urine. The tongue is protruding and there is continued frothing, accompanied by occasional whining.

1325 The dog is standing with difficulty and has apparently lost the ability to walk. There is a sudden large discharge of the bowels. The tongue is still protruding and frothing continues.

1326 The dog is now lying down with the legs and feet spread obliquely outward. There is no attempt to rise or walk. Frothing is still profuse and whining continues. The ears have been held forward throughout the experiment.

1329 Breathing is rapid and occasional convulsions are again evident.

1332 The dog is recovering its coordination, although the attempts to rise are very awkward. There has been no obvious loss of alertness so far. Occasional convulsions continue as well as the profuse frothing from the mouth.

1335 The stance of the dog has noticeably improved. Respiration remains heavy and regular. Slight convulsions still continue. Attempts at locomotion display lack of coordination and frothing continues to be profuse.

1337 The stance is still tense and unsteady and there is no attempt at locomotion. A rapid opening and closing of the mouth and "smacking of the lips" appear as if the dog is trying to reject something from its mouth. The dog is still alert to activities about him and frothing continues to the same degree.

1340 The tongue is retracted into the mouth for the first time. Saliva is still flowing heavily.

1343 The dog appears fresh and alert. There has been almost complete recovery of coordination and walking ability is only slightly less steady than normal. Water was offered the animal but it was not taken. There is still a heavy flow of saliva.

1345 The dog is showing interest in objects about the room. Walking and "quick" walking abilities appear normal. The profuse flow of saliva continues.

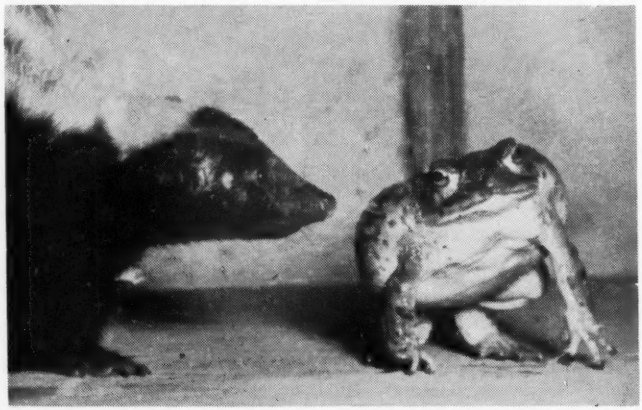
1350 Normal activity is apparent. The frothing has noticeably lessened and water is again refused. The actions have again become typically those of a puppy.

1352 Activity is continued normal and frothing has finally ceased.

It seems obvious that if *B. alvarius* should be subjected to predatory attack, any pressure from the teeth of a predator upon the granular glands could discharge toxins into the mouth. The possession of such a mechanism would be an adaptation of survival value. Further tests to establish the effectiveness of defense mechanisms were executed and the results

would indicate that both behavioral and physiological adaptations are utilized in defense. On the basis of the following information the authors selected *M. mephitis* as a test animal.

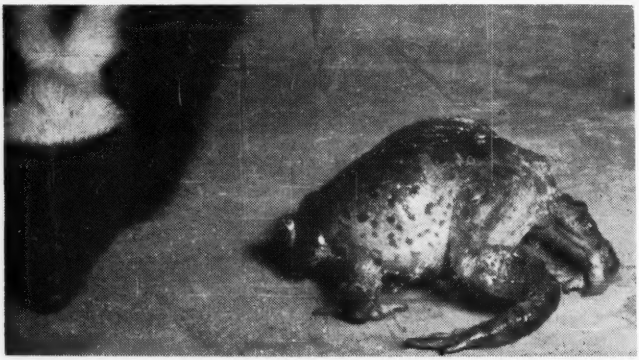
Miller and Kellogg (1955) describe the range of *M. mephitis estor* Merriam, as the "Western third of New Mexico across Arizona to northeastern Baja California and southeastern California (Colorado River Valley); . . ." On six separate occasions during investigations for the present paper the authors have recorded observations on the occurrence of *M. mephitis* in the delta lands of the Colorado River and the irrigated regions occupied by *B. alvarius*. Grinnell, Dixon and Linsdale (1937) state that the Striped skunk lives in cracks and crevices which form naturally in the levees in the delta regions and that culverts offer preferred routes of travel. It is interesting to note here that the most satisfactory results in collecting *B. alvarius* were obtained along the margins of irrigation ditches, especially at irrigation locks and culverts crossing under the roads. Grinnell, Dixon and Linsdale (*op. cit.*) have also reported that amphibians were found in six of twenty-one stomachs of *M. mephitis* examined and that these comprised 0.3% of the bulk contents.



B. alvarius assuming defensive posture upon approach of skunk. Efforts to adjust position to keep dorsum facing the skunk have resulted in elevation of the left side of the body.

The adult male *M. mephitis* used in the laboratory experiments had been "deodorized" by removal of the scent glands but was not tamed. While being kept in the laboratory it was frequently fed *Rana catesbeiana* Shaw, *Bufo boreas halophilus* and *Bufo woodhousii*. These anurans were immediately accepted as food by the skunk, and as soon as an individual (or more than one) was put into the cage it would be pounced upon. The skunk then began a typical shuffling action of scratching and scraping with the front feet upon the back of the prey. This activity was continued until the victim was all but dead, and often took as long as from five to fifteen minutes depending upon its size. Once the victim had been injured

to the extent that no resistance or attempt to escape was apparent the skunk would begin biting and tearing at the head until it was dead and then continue feeding upon it. On occasion the feeding would begin at the legs, depending upon the position of the prey when it had been killed. There was no apparent selection of the parts of the animal which the skunk would avoid or reject as food, for the skin and granular glands were often eaten first or last, or sometimes left uneaten in different individuals of the same species. The authors have no reason to believe that differences in the conditions of the frogs and toads that were offered as food could have influenced the activities of the skunk, as many of those offered were captured at the same localities and were kept under similar conditions for similar lengths of time. It is believed that whatever part of the victim was left was only a result of chance or satiation of appetite.



A typical but not extreme defensive posture. This position is often further exaggerated by increased extension of the legs resulting in elevation of the entire body.

When a large female *B. alvarius* was placed in the cage with the *M. mephitis* it was immediately attacked by the skunk in the manner described. The toad, however, was strong enough to escape from under the weight and grasp of the skunk and in two quick leaps covered a distance of about three feet. The skunk immediately followed the toad and upon the second approach the latter raised itself high on all four legs, inflated its body greatly with air, bent the head downward and inclined the body forward so that the dorsal surface was towards the skunk (see plates I and II). This was followed by a very audible hiss from the toad as it slowly forced air from its lungs. The skunk approached more closely, sniffed at the toad and then backed away. The toad was left in the cage with the skunk for twenty-five minutes and except for occasional sniffing activity on the part of the skunk, the toad was not disturbed. On each approach of the skunk the toad would assume the defense posture and hiss audibly. Depending upon the movements and approaches of the skunk the toad would attempt to adjust its position so that the head and dorsum were facing towards the antagonist. On occasions of apparently

extreme attempts at this defensive posture one of the forelimbs would be completely elevated from the substratum as the other was gradually flexed in an effort to keep the dorsum towards the skunk, especially when the latter would approach closely with the head lowered. Each time the skunk would react to this by backing away and, for a short time at least, giving no attention to the presence of the toad.

Following the removal of the toad used in the above experiments a smaller female *B. alvarius* was placed in the cage and the skunk displayed immediate interest and approached it. This toad exhibited the "typical" defense posture and actually leaped at the skunk from this position. The release of two more *B. alvarius* into the cage stimulated the attack upon one of these by the skunk, which pinioned the toad with its forefeet. This toad was able to escape and assumed the defense posture. The skunk retreated and as it moved away passed near the large female used in the first part of these observations. The latter toad jumped at the skunk, hitting it in the flank. A second jump by this toad immediately followed and this time hit the skunk in the neck region. A third attempt missed the skunk. These leaps were a butting action and the mouth of the toad remained closed. At no time did the skunk appear frightened, but it was wary of the toads. Repeated experiments of this type soon resulted in conditioning the skunk so that adult *B. alvarius* would be ignored after a momentary initial interest when the toads were introduced to the cage. The skunk continued to feed upon *Bufo woodhousii*, *Bufo boreas* and adult *Rana catesbeiana* without hesitation.

On another occasion a medium-sized female *B. alvarius* was placed in the cage with the skunk and although the skunk seemed aware of the toad, it displayed a complete lack of interest in it. A second female *B. alvarius* was also placed in the cage and leaped in the general direction of the skunk without any apparent intent. The skunk immediately assumed a defense posture by turning its posterior towards the toad and raising the tail as if to spray. There was no indication of any defensive behavior on the part of the toads on this occasion. A *Rana catesbeiana* of similar coloration and a size intermediate to the two *B. alvarius* already in the cage was introduced. The bullfrog, after one jump in the direction of the skunk, was immediately attacked and pinioned against the floor of the cage by the skunk, which then continued the scratching and scraping with the front feet and began eating the frog before it was dead. After the *Rana* had been partially eaten it was forcibly taken from the skunk. The skunk then chased hurriedly and excitedly about the cage, but yet refused to attack the two *B. alvarius* present. Throughout the attack on the *Rana* the toads appeared undisturbed by the skunk's activity and displayed no defensive behavior during this time or after the removal of the bullfrog. The *B. alvarius* were then removed from the cage.

Within five minutes after the previous experiment an adult *Bufo woodhousii* and a slightly smaller *B. alvarius* were simultaneously introduced to the cage. The skunk immediately attacked the *B. woodhousii*. The latter was taken from the skunk and the smaller *B. alvarius* nearby was attacked. It is very conceivable that this toad was mistaken for the former one. The toad exhibited no defensive behavior up to this time other than the typical generic defense of inflating itself after the attack. The skunk, during its attempts to kill this toad, would on occasion lick

the paratoid glands and respond to this by violently shaking its head and licking the outside of the mouth. The attack continued for a period of ten minutes, during which time the skunk was obviously disturbed by the secretions of the toad. It would react further by baring the canines, snorting and vigorously shaking the head and forepart of the body. Occasionally heaving convulsions without regurgitation were noted. After ten minutes the skunk ceased its attack on the toad and retreated to the opposite side of the cage. The toad then, without any apparent disabilities, hopped away from the point of attack although its back was raw and bleeding slightly. At this time the right parotoid gland was noticeably smaller than the left one but there was no indication of injury to the gland itself. The skunk continued to exhibit normal responses and was not observed to suffer further from any effects of the secretions. Four days later the *B. alvarius* died, apparently as a result of the wounds inflicted by the skunk.

DISCUSSION

During the experiments upon the defensive behavior of *B. alvarius* the writers did not observe any voluntary ejection of secretions from any of the granular glands of the toads. Dr. R. B. Cowles has stated (pers. comm.) that he has observed one of these toads, which was in a state of extreme agitation induced by rough handling, to assume the described defense posture and also to bend the head sharply downward. A single ejection was observed, but the distance was not determined. The secretions also appeared on the surfaces of the parotoid glands. Other known records of such ejections include those recorded by Budgett (1899) and Muhse (*op. cit.*). The former reported, of *Bufo marinus*, "the parotid (*sic*) glands are enormously developed, and, if the toad is roughly handled, are discharged like squirts." Muhse (*op. cit.*), working with *Bufo americanus* Holbrook, reported surface secretions upon electrical stimulation of the paratoid glands *in situ* and when freshly extirpated. Chen and Chen (1934) report that "the toad" does not squirt its poisonous secretions when stimulated mechanically and obtained only surface secretions upon slight electrical stimulation.

Chen and Chen (1933) have found the secretions of the granular glands of *B. alvarius* to contain large amounts of ergosterol and some cholesterol. The only active principles so far obtained from these secretions are alvarobufotoxin (a digitalis-like substance the formula and structure of which is yet unknown) and alvarobufotenine, which was obtained as a flaviniate. No epinephrine has been discovered in any of the cutaneous gland secretions of this species.

Chen and Chen (1934), referring to toads in general, make several statements indicating a lack of effective defensive behavior, lack of effective utilization of toxins and lack of observable effects caused by toxins when ingested. The results of the present investigations oppose the application of these generalizations to *B. alvarius*. Smith and White (1955) in their study of adrenal enlargement in certain snakes have established inferential evidence which would support the present writers' point of view.

CONCLUSIONS

The results of the experiments definitely indicate a lack of volatility of the toxins of *B. alvarius*. However, it has been established by numer-

ous investigations to be a potent and quick-acting toxin when applied directly to mucous membranes of certain animals. It is of particular interest to note the reported absence of epinephrine in the parotoid secretions of *B. alvarius*. The rapid rate of absorption of the secretions discharged into the mouth of a dog indicate that such was accomplished in the pharyngeal epithelium. As this action is not known to occur in any of the digitaloid substances, only bufotenine among the substances known to be present (and which has an action similar to epinephrine) could have initiated such an immediate response.

It would appear that the possession of these toxins, the defense posture and aggressive behavior, supplemented by the large size of the adults of this species, is a combination forming an effective defense mechanism. Such conditioning as exhibited by *M. mephitis* in the laboratory could occur readily in nature and may offer some indication of the survival value of these defensive abilities in *B. alvarius*.

A further understanding of the ecology of this species is required before more natural behavior and functioning of defense devices can be discerned. The writers are continuing investigations of these and related problems.

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EFFECT OF MARINE TOAD TOXINS ON MAN.—The parotoid glands of some large toads secrete substances toxic even to sizeable vertebrates. Dogs have been seriously affected or even killed by the secretions of *Bufo alvarius* Girard (Musgrove, 1930, Copeia 173: 96) and of *B. marinus* (Linnaeus) (Dodds, 1923, Copeia 114: 5). Musgrove experienced brief illness after ministering to a dog that had bitten a toad of the former species; and a man died in consequence of eating the latter (Rabor, 1952, Copeia 4: 282). The clinical effects of *B. marinus* toxins on man have been discussed by Novaro in several papers (1922, Rev. Asoc. Méd. Argentina, Sect. Soc. Biol. 35: 715; Compt. Rend. Soc. Biol. 87: 824; 1923, *ibid.*, 88: 371, 461; Rev. Criminol. Psiquiat. Med 10: 409). However, comparatively little attention has been given to the unpleasant symptoms that may result simply from handling the "marine" toad. In this connection two case histories may be of interest.

An employee of the Reptile Institute opened a crate of *Bufo marinus* which had been shipped from Barranquilla, Colombia. The unpacking was done out-of-doors. The man did not seize any the toads but merely shook and gently prodded them from the box into a pen. Although noticing no ill effects at the time, about three hours later he experienced mild nausea and headache, which persisted for several hours thereafter.

Another employee was segregating male from female specimens of *Bufo marinus* in a large shipment from Barranquilla. He picked each toad up by a hindleg, glanced at its throat (which was dark and wrinkled in the breeding males), and then dropped the amphibian into a container. In this fashion he handled several dozen toads. He felt no ill effects for about two hours, when a headache began to develop. This intensified markedly, and the man went home to bed. He was unable to sleep that night, on account of the severe headache and a mounting nausea. Vomiting began about 2:30 A.M. and continued at very frequent intervals for about three hours. Afterward, there was occasional retching, and at 8:30 A.M. medical attention was sought. A physician prescribed Coca-Cola, which was taken. Symptoms gradually subsided; and by 11:00 A.M. the man, a little weak and pale, returned to work. For hours thereafter he experienced a pain in the back of the throat, perhaps brought on by the severe vomiting and retching.

The toxic secretion of *Bufo marinus* has been investigated by Abel and Macht (1911, Jour. Amer. Med. Assoc. 56: 1531; 1912, Jour. Pharm. Exptl. Thera. 3: 319), Jensen and Chen (1930, Jour. Biol. Chem. 87: 755), Chen and Chen (1933, Jour. Pharm. Exptl. Thera. 49: 514), Jensen and Evans (1934, Jour. Biol. Chem. 104: 307), and by Tschesche and Offe (1936, Ber. Deutsch. Chem. Gesellsch. 69B: 2361), among others. It contains a bufagin and another substance which has been called marino-bufotoxin. Both compounds are digitalis-like in pharmacological action, and the latter is a powerful emetic. The secretion also contains epinephrine and presumably cholesterol. Thus its effects on man are not surprising.

We have collected many *Bufo marinus* by hand and have experienced no unpleasant symptoms. Perhaps this toad normally releases its toxic secretion only under the combined stress of danger and pain, as appears to be the case of *B. alvarius* (Kellogg, 1932, U. S. Nat. Mus. Bull. 160:

37). Nevertheless, care is warranted in handling these amphibians, for the behavior of occasional specimens may be unpredictable.

It may be mentioned that the secretion of *Bufo marinus* is not toxic to all vertebrates. At Soledad, Colombia, the senior author collected one specimen of a snake, *Helicops* species, which had nearly swallowed a marine toad, and a second which had seized one of these amphibians by the hindleg. Pope (1955, The Reptile World: 22) described the finding of a marine toad in the stomach of a broad-nosed caiman *Caiman latirostris* (Daudin).—*E. Ross Allen and Wilfred T. Neill, Research Division, Ross Allen Reptile Institute, Silver Springs, Florida.*

THE EFFECTS OF A MASSASAUGA BITE.—Carl Kemp, while hunting and collecting Massasaugus (*Sistrurus catenatus catenatus* Rafinesque), suffered a bite from a large, heavy-bodied specimen measuring twenty-three inches in total length. The following incidents are recorded by the author, as told him by Carl Kemp on the following morning.

At 9:15 A.M., after locating and attempting to pick up this pinned specimen, it slipped from under the wet pinning stick and bit Carl severely on the right thumb, between the first and second joints. Both fangs were deeply imbedded in the flesh and the snake shook viciously while injecting the venom. The snake was captured and turned over to me the following morning.

After being bitten, Carl immediately made one cut over each fang mark and began to walk to his house, which was three-quarters of a mile distant. After arriving home, he was driven to the doctor. Thirty-five minutes elapsed from the time of the bite until he reached the doctor's office. The hand had begun to swell. The swelling progressed and finally stopped about eight inches above the bite. The hand was now two and one-half times its normal size. The doctor made four cuts, two over each fang puncture, then applied a tourniquet and suction.

There was no pain about the bite, but, as Carl related, "just a dead feeling." There was no nausea nor was there any temperature change; respiration was also normal.

After the treatment at the doctor's office, Carl was taken to the Butler Hospital for additional treatment. This consisted of the following: 1500 units of tetanus anti-toxin; penicillin SRD; and North American serum for snake bite manufactured by Wyeth Laboratories. The serum was given with two injections, 7.5cc injected subcutaneously into the edematous area about the bite and 7.5cc into the muscle of the upper arm. The hand was bathed in a saline solution overnight to reduce swelling.

At 11 A.M. on the morning following the bite, Carl arrived home from the hospital. The hand was still twice its normal size, but having no ill aftereffects, Carl proceeded to hunt snakes with me, as had been our original plans for that day.

One week later his right hand broke out in a red rash that was irritable and itchy. This was caused by either the penicillin or the anti-toxin, but it was not determined which was to blame. After several days, the rash entirely disappeared.

The previous fall, Carl had been scratched by a Massasauga in an attempt to shift it from a box to a bag. With suction and no antivenin he suffered no ill effect from the scratch.—*William B. Allen, Jr., Highland Park Zoological Gardens, Pittsburgh, Penna.*

A RECORD OF VIVIPARITY IN A NORMALLY OVIPAROUS SNAKE.—A specimen of *Diadophis punctatus punctatus* Linnaeus from Miami, Florida, gave birth to six living young on May 21, 1955. This took place two weeks following capture by Michael Geison. The adult snake had been confined to a cage with only a water dish; no possible hatching medium was present to conceal eggs. Parturition took place during the night. The average total length of the offspring was 92 mm., with a range of 89 to 99 mm. The colors of the parent and juveniles were nearly the same, the mother being somewhat darker. The dorsal color was dark slate, the venter and ring were chrome yellow, and the distal venter of the tail reddish-orange. These specimens were lost due to death and subsequent decay that was not detected until it was too late to preserve them, but they were positively identified by the collector, L. N. Bell and the author. It is possible that this phenomenon is not uncommon in this area, although Blanchard (1942, Bull. Chicago Acad. Sci., 7: 11) states that the species of *Diadophis* "all, presumably, lay eggs." Furthermore, no other species of snake normally laying eggs is noted in the standard compendia as ever having given birth to its offspring.—*H. W. Peterson, 7708 Chappel, Chicago 49, Ill.*

OBSERVATIONS ON FEEDING OF A JUVENILE *CONSTRICTOR CONSTRICTOR*.—A newly-born *Constrictor constrictor* (Linnaeus) acquired in early 1955 from the Wholesale Division of Ross Allen's Reptile Institute in Miami fed readily, as the species is wont, upon new-born chicks and white mice. Within two months, on five feedings, it had increased its total length to 60 cm. from an original length of about 35.5 cm. A baby Rainbow Boa, *Epicrates cenchris* (Linnaeus), was eventually confined in the same cage with the boa where they peacefully co-existed for some time. In order to avoid competitive feeding, the *Constrictor* was removed from the cage during the first meal of the Rainbow. The *Epicrates* took a young mouse, and after it was finally settled in its stomach (25 minutes later) the *Constrictor* was returned to the cage. It immediately began foraging about and within a minute bit the *Epicrates* at the site of the mouse, and threw several coils around it. In fear that the Rainbow would be lost, the two were separated, but with difficulty. The response exhibited by the *Constrictor* may have been stimulated directly by the bulge in the attacked snake; by a thermal cue that the snake was able to detect from the mouse through the body wall of the *Epicrates;* or by odors from the mouse; or by a combination of these factors. It may be added that the *Constrictor* quickly attacked any *warm* object placed in its cage (including its keeper's hand). No records of outright ophiophagy in this genus are known to me, and no direct ophiophagous intent need be surmised in the present case.—*H. W. Peterson, 7708 Chappel, Chicago 49, Ill.*

CALLISAURUS DRACONOIDES RHODOSTICTUS COPE REVIVED FOR THE WESTERN FRINGE-FOOTED LIZARD, *CALLISAURUS DRACONOIDES GABBI* COPE.—*Callisaurus rhodostictus* Cope (Amer. Nat., vol. 30, Dec. 1896, pp. 1049-1050) has generally been regarded as a synonym of *C. crinitus* Cope (=*C. draconoides crinitus*), named and described on page 1049 of the same article as the preceding. The type (U. S. Nat. Mus. 14895) of *C. crinitus* was cited by Cope, and the type locality (cited as "Lower California" in the original description) has subsequently been narrowed to Ballenas Bay through data associated with the type. The type for *C. rhodostictus* was not cited by Cope, and has been listed by no subsequent authors. The records of the U. S. National Museum indicate, however, that the specimens bearing the USNM Nos. 21504-11 are the cotypes on which the name is based. Cope did not cite the provenience of the types of *C. rhodostictus*, and in fact apparently he did not know it, for his only indication is: "Numerous specimens from lower California from A. W. Anthony. As this species was accompanied by *Uta parviscutata* V. den B. and *Crotalus ruber* Cope, the locality is not the Cape San Lucas country." Cope's deduction was correct for the cotypes actually bear the locality data of El Rosario (No. 21504) and "San Fernando, 60 mi. S. San Quintin, 20 mi. from Pacific Ocean" (Nos. 21505-11), two closely approximated localities on Pacific slopes of northern Baja California at the 30th parallel.

Assuming that "Baja California" was the only locality information available, and that *C. rhodostictus* had correctly been allocated to the synonymy of *C. draconoides crinitus*, Smith and Taylor (Bull. U. S. Nat. Mus., No. 199, 1950, p. 87) restricted the type locality of *C. rhodostictus* to Santo Domingo, a well-established locality of occurrence of *C. d. crinitus*. This restriction is nullified by the discovery that the actual locality data for the types are available.

We hereby designate U. S. Nat. Mus. No. 21511 as the lectotype, thus restricting the type locality of *C. rhodostictus* to San Fernando. This specimen is the best preserved and largest male of the entire series, with the snout-vent measurement 84 mm., hind leg from groin to tip of longest toe 82 mm., tail 120 mm. The femoral pores number 15, the interparietal and supraorbital semicircles are completely separated, the dorsal tail bars are black, and the sides of the belly are marked with only two oblique lateral black bars. The other cotypes, Nos. 21504-10, are hereby designated lectoparatypes. None of the male lectoparatypes (Nos. 21508-10) possess more than two lateroventral black bars on the abdomen, contrary to Cope's description; their femoral pores vary from 13 to 15.

The locality data, structure, and color of the type series of *C. rhodostictus* reveal that these specimens represent not *C. d. crinitus*, which occurs no nearer than some 110 miles to the southeast (Tevis, Copeia, 1944, p. 11), but the subspecies currently known as *C. d. gabbi* Cope (Ann. Rep. U. S. Nat. Mus. for 1898, 1900, p. 272). The localities represented actually lie at the northern edge of the range of the species on Pacific slopes of Baja California; no question thus can arise of the allocation of the name.

Since *C. rhodostictus* Cope 1896 antedates *C. v. gabbi* Cope 1900 by four years, the former name takes precedence over the latter; the sub-

species heretofore known as *C. d. gabbi* Cope accordingly should be recognized as *Callisaurus draconoides rhodostictus* Cope. The only alternative is an appeal to the International Commission on Zoological Nomenclature for exercise of its plenary powers to effect preservation of the name *C. v. gabbi* Cope, in its current application, and suppression of the name *C. rhodostictus*. In our opinion, literature references to the subspecies involved are so limited they do not justify appeal to the International Commission.—*Hobart M. Smith and Doris M. Cochran, Department of Zoology and Museum of Natural History, University of Illinois, Urbana, and U. S. National Museum, Washington 25, D.C.*

NOTES ON FOOD OF A CAPTIVE BLACK SWAMP SNAKE, *SEMINATRIX PYGAEA PYGAEA* (COPE).—In herpetological literature there have been only a few scattered references to the feeding habits of *Seminatrix pygaea*. Ditmars (1907: Reptile Book) reported that this species would not accept such food as young frogs, fishes, earthworms, and salamanders. He later stated (1940, Rept. N. Amer.) that *Seminatrix*, when provided with a tank filled with aquatic plants, appeared to feed upon very small minnows. Dowling (1950, Misc. Publ. Mus. Zool. Univ. Mich., 76) came to the conclusion, after examining 61 stomachs and observing the feeding habits of captive specimens, that *Seminatrix* did not feed on fishes at all. At the same time he discovered that this species does feed on oligochaete worms, leeches, adult and larval Cricket Frogs (*Acris gryllus dorsalis* Harlan), and moderate-sized Mud Sirens (*Pseudobranchus striatus axanthus* Netting and Goin). Allen (1941, Florida Water Snakes) observed this snake to feed on worms and small eels. Barton (personal notes, 1948) commented that captive specimens refused tubificid worms and white threadworms, but took earthworms quite readily.

On April 19, 1954, Mr. Roger Conant of the Philadelphia Zoological Gardens provided a juvenile female *Seminatrix* which enabled me to make the subsequent observations. It was collected February 6, 1954, at Haile's Siding, Payne's Prairie, Alachua County, Florida, by Mr. Walter Auffenburg and Mr. Richard Johnson. It measured 163 mm. in length and agreed with Dowling's series (*op. cit.*) both in scale counts and ventral color pattern.

The specimen was housed in a wide-mouth, five-gallon jar in which a quantity of sphagnum moss had been placed and covered with water to the depth of one-half inch. During the period of observation the snake remained under the moss with only the tip of its nose extending out of the water. A small piece of bark was provided so that the snake could come out of the water, but the bark was removed when the specimen did not take advantage of it. The snake never developed blisters, a condition frequently occurring in snakes of other species placed under similar circumstances. This fact tends to be indicative of this species' adaptation to an aquatic habitat in its natural environment.

The snake readily took a great variety of food items. Between April 19 and September 4 it consumed at irregular intervals: five larval Dusky Salamanders (*Desmognathus f. fuscus* Rafinesque); a newly transformed

toad (*Bufo sp.*); seven minnows, averaging between 27 mm. and 30 mm. in length; a sunfish approximately 28 mm. in length; and five earthworms. Regurgitation of all earthworms occurred within 24 hours after their ingestion. Barton (1948) noted a similar set of circumstances and suspected ". . . that the soft parts were at least partially digested out." The fact that the specimen of *Seminatrix* under observation ate minnows so readily appears to substantiate Ditmars' earlier observation.

The specimen died on September 22, 1954, from causes unknown although a dietary deficiency was suspected. Its duration in captivity was 8 months 16 days, which compares well with 2 of Barton's specimens which survived 8 months 22 days and 8 months 20 days.

I would like to express appreciation to Mr. Roger Conant for providing the *Seminatrix*, Dr. Herndon G. Dowling of the University of Arkansas for the loan of Barton's notes, and Dr. Coleman J. Goin of the University of Florida for helpful suggestions.—*Douglas A. Rossman, Department of Zoology, Southern Illinois University, Carbondale, Illinois.*

AN UNUSUAL FEEDING HABIT IN THE BOX TURTLE.—A subadult *Terrapene carolina triunguis* (Agassiz) captured in St. Louis, Missouri, in the summer of 1950, exhibited a behavior when confronted with mealworm larvae (*Tenebrio obscurus*) that I have not observed in similarly exposed box turtles. Rather than kill and eat one larva at a time, it would first pick up each in turn, and with a few bites would kill or effectively disable it. When all were rendered incapable of escape, the turtle would start its meal. This same reaction was observed on the several occasions when more than one larva was offered. Unfortunately, the specimen died after a short time in captivity. It is a matter of conjecture whether this behavior may be interpreted as an act of reasoning. —*Charles W. Myers, 1559 Tamm Ave., St. Louis 10, Missouri.*

A RECORD LENGTH FOR THE ARIZONA CORAL SNAKE.—A specimen of *Micruroides e. euryxanthus* Kennicott measuring 551 mm. (21⅝ inches) in length and 10 mm. in diameter was collected five miles north of Wickenburg, Yavapai County, Arizona, on November 30, 1955, by Mr. A. B. McMillen. The snake, which was found hibernating 3½ feet under the surface of the ground, constitutes a record length for the subspecies, the longest previous recording being that of Oliver (1955, North American Amphibians and Reptiles: 301) who mentions a maximum length of 19½ inches for *Micruroides euryxanthus.*

The specimen is number 9328 in the collection of Dr. Frederick A. Shannon, Wickenburg, Arizona.—*Gerald O. Gates, Wickenburg, Arizona.*

A Blotch-Count Gradient In Snakes

By PHILIP W. SMITH

In the course of a distributional and variational study of the amphibians and reptiles of Illinois, an exceptional opportunity has been afforded to discern north-south clinal variation inasmuch as Illinois extends almost 400 miles from its northernmost to its southernmost point. The most frequently observed north-south gradient in the snakes is the decreasing number of dorsal blotches or bars on those species possessing spotted, ringed, or transversely banded patterns.

The more extensive pigmentation of more northerly populations is not surprising because this phenomenon is well known in such animal groups as insects, mammals, and birds. In fact, this variation in the birds has long been recognized as Gloger's Rule. The occurrence of such a cline in reptiles has also been suggested by various studies of geographic variation in which southern subspecies of blotched snakes tend to have fewer and smaller dorsal blotches as well as wider interspaces than the more northern races.

Fourteen of the 36 species of Illinois snakes lend themselves to analysis because they have transverse bars, rings, or dorsal blotches which can be counted accurately and because they have sufficient north to south range in the state for geographic variation to be discerned. The remaining 22 species either have patterns unsuitable for analysis or have ranges too small to illustrate geographic variation. Nine of the fourteen species analyzed exhibit a trend toward greater number of dorsal body blotches and narrower interblotch spaces in the north. These nine species also display more extensive pigmentation toward the north in the larger size of the alternating lateral spots and corresponding smaller size of the interspaces. None of the five remaining species shows a reverse cline.

Illinois has been divided arbitrarily into five zones, fig. 1. Although specimens available from all localities within one of these zones have been lumped, this does not mean that each species is distributed throughout that zone.

Of the nine species with a progressive increase in blotch counts to the north, two (*Lampropeltis triangulum* and *Natrix sipedon,* table 1) have two or more well-marked subspecies, and the variation represents stepped clines. Their subspecies can be diagnosed by the number of dorsal blotches and the number of tail rings as well as by other characters. Although sexual dimorphism occurs in the number of tail rings and to a lesser degree in the number of body blotches, these two counts for both sexes have been lumped because the combined data do not appreciably alter the general trend.

Lampropeltis triangulum (Lacépède). The first sample, from the northern third of the state, is regarded as representing a population of typical *L. t. triangulum;* the north-central sample, *L. t. triangulum* x *syspila;* the south-central and the southern samples, typical *L. t. syspila.* The transition from more to fewer dorsal blotches is accelerated in the sample from north-central Illinois. This step in the gradient coincides with the zone of intergradation between the two subspecies. If intraracial clines are present, they are too slight to be discerned.

Natrix sipedon (Linnaeus). The northern sample is regarded as representing a population of *N. s. sipedon;* the samples from north-central and south-central Illinois, *N. s. sipedon* x *pleuralis;* the southern sample (excluding Horseshoe Lake in the extreme southern tip of the state), *N. s. pleuralis;* and the Horseshoe Lake sample, as nearly typical *N. s. confluens.* The step in the gradient illustrated by the north-central and south-central samples is not steep but it coincides with the zone of intergradation between *N. s. sipedon* and *pleuralis.* The step between the southern and Horseshoe Lake samples is abrupt, and intergrades between *pleuralis* and *confluens* are lacking.

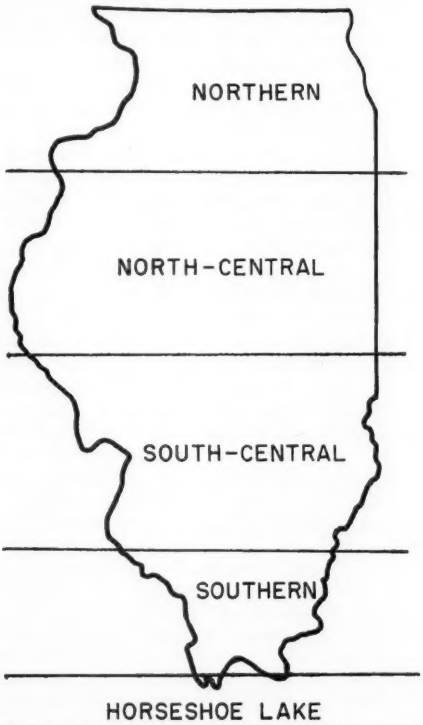

Fig. 1. Geographic zones utilized in analysis of geographic variation of snakes in Illinois.

Of the nine species analyzed, seven (table 2) show a north-south gradient in average number of blotches, and this variation is intraracial rather than subspecific. The number of tail rings, when they can be counted, seems to accompany the decrease in number of body blotches toward the south. Because of the sexual dimorphism and the frequently unbalanced sex ratios of the samples available, the tail ring data for these species have been omitted.

Heterodon platyrhinos (Latreille). All of the samples in table 2 are currently regarded as representing a single population, *H. p. platyrhinos.* The cline is slight and discernible only in the high blotch count average of the northern sample.

Elaphe obsoleta (Say). The first three samples in table 2 are currently regarded as representing the nominate subspecies, although the presence of color subraces is indicated by other data. The southern sample is actually representative of an *E. o. obsoleta* x *spiloides* intergrade population and contains only specimens from southwestern Illinois. The *obsoleta* population in extreme southeastern Illinois has similar blotch counts, but it has been omitted since other characters suggest that it is referable to *E. o. spiloides.* The gradient is slight and, as in *Heterodon platyrhinos,* most pronounced in the northern sample.

Lampropeltis calligaster (Harlan). All of the samples belong to the subspecies *L. c. calligaster.* This species is noteworthy because the cline is exhibited only by males. Females from all three zones in which the species occurs and males from the southern sample average about 45 body blotches. Males from the south-central zone display an average of 47.1 blotches, and from the north-central zone, 50.2 blotches. The three figures in table 2 are based on combined counts of males and females.

Sistrurus catenatus (Rafinesque). The two samples available are referable to the nominate subspecies, *S. c. catenatus.* Although a decrease in average number of body blotches toward the south is apparent in both sexes, the trend is somewhat more pronounced in males.

Heterodon nasicus (Baird and Girard). The north-south cline is surprisingly pronounced in some species which have relatively restricted ranges within the state. *H. nasicus* occurs in relict populations in the scattered sand prairies along the Mississippi River in northwestern Illinois (Rock Island to Henderson counties) and in the sand prairie along the Illinois River (Tazewell to Morgan counties). The specimens from northwestern Illinois are rather homogeneous and usually have more than 35 body blotches. For this reason the population is referable to *H. n. nasicus,* despite the fact that these colonies are well removed from the Great Plains population. The relict population in the Illinois River sand area in central Illinois, however, shows a marked decrease in blotch counts toward the south. The northern members of this colony (Tazewell to Mason counties) have nearly as many blotches as does *H. n. nasicus,* whereas the southern specimens (Morgan County) have few enough to be assigned to typical *H. n. gloydi.* An isolated population in extreme southeastern Missouri also has a reduced blotch count and appears to be typical *gloydi.* Although the cline is unmistakable in the species, this is not to imply that *gloydi* is a questionable subspecies. In fact, the data available suggest a step in the cline which probably corresponds to the area of intergradation.

Elaphe vulpina (Baird and Girard). Variation found in the fox snake (*E. vulpina*) is of particular interest inasmuch as a few herpetologists consider it a monotypic species, although an isolated colony near Lake Erie has been described as *E. v. gloydi* on the basis of a reduced blotch count. The distinctness as an entity of *E. v. gloydi* has been questioned by many field zoology students at the University of Illinois inas-

much as local specimens, as often as not, are intermediate in the "key" blotch character between *E. v. gloydi* and presumably typical *E. v. vulpina.*

Elaphe v. vulpina has 35-51 (average 41) dorsal blotches; *E. v. gloydi* has 28-39 (average 34). The north-central sample in table 2 shows that central Illinois specimens are actually somewhat intermediate between the two races, but northern Illinois fox snakes can be readily assigned to *E. v. vulpina.* If the cline is projected northward, the progressively higher number of blotches can be tested and substantiated by available specimens. Breckenridge (Reptiles and Amphibians of Minnesota, Univ. Minnesota Press, 1944) records the blotch count of 39 specimens from the northern edge of the range of the species as 36-56 (average 43.1). If the cline is projected southward, it is evident that specimens with sufficiently low counts to be referred to *gloydi* should occur in southern Illinois. However, the range of the species terminates abruptly at the Shelbyville Moraine, and the fox snake does not occur anywhere in the southern half of this state.

The isolated Lake Erie population, although latitudinally equivalent to northern Illinois, is climatically closer to southern Illinois; and the plant growth zone in which the range of *gloydi* is situated in Ohio is uninhabited by fox snakes farther west. Thus, although the blotch count reduction in the Missisippi River States is a sloped cline, the southernmost specimens approach *gloydi* in the mean number of body blotches but never attain the low mean characteristic of this race. The Lake Erie population is definable morphologically as well as geographically, and it is convenient for zoogeographic reasons to retain the name *gloydi* for this isolated relict.

Pituophis catenifer (Blainville). The samples in table 2 belong to the subspecies, *P. c. sayi.* The blotch count gradient is similar to but less pronounced than in the preceding eight species.

There is fragmentary evidence within Illinois that some species of snakes with uniform color or striped patterns also tend to be darker toward the north. These examples are not readily demonstrable, however, and other species seem to provide contradictory data.

Those species which have spotted or banded patterns and sufficient range in the state for a gradient to be discernible but which nevertheless fail to display the phenomenon are: *Natrix rhombifera* (Hallowell), *Crotalus horridus* Linnaeus, *Lampropeltis getulus niger* (Yarrow), *Ancistrodon contortrix* (Linnaeus), and *Ancistrodon piscivorus* (Lacépède). The reasons for the absence of similar variation in these species, the first two of which have particularly wide ranges in the state, are unknown.

The blotch count gradient pointed out here is based on small samples in a comparatively restricted geographic area, and it may reflect some zoogeographic peculiarity of the upper Mississippi Valley region. Its regularity in about two-thirds of the species which could be expected to exhibit such variation and the absence of a reverse cline suggest that it may be a generalization applicable to snakes as a group. It should be tested in other areas, however, and I hope that this paper will stimulate similar studies. The foregoing data demonstrate that caution must be exercised both in utilizing blotch counts as taxonomic characters in new forms and

Table 1. Geographic Variation in Selected Characters of Two Species of Snakes.

Sample	No. of specimens	Body blotches	Tail rings
	Lampropeltis triangulum		
Northern Illinois	12	42-52 (46.2)	8-12 (9.4)
North-central Illinois	19	21-38 (28.3)	6-11 (7.7)
South-central Illinois	5	19-26 (22.6)	4-6 (5.5)
Southern Illinois	9	20-26 (23.0)	4-7 (5.8)
	Natrix sipedon		
Northern Illinois	22	30-40 (36.2)	17-27 (23.0)
North-central Illinois	56	25-44 (32.2)	16-23 (18.9)
South-central Illinois	31	24-33 (27.6)	14-29 (19.2)
Southern Illinois	25	22-28 (24.7)	11-18 (19.2)
Horseshoe Lake	21	14-26 (18.3)	.....

Table 2. Geographic Variation in Selected Characters of Certain Snakes in Illinois.

Species	Northern		North-central		South-central		Southern	
	No. of specimens	Body blotches	No. of specimens	Body blotches	No. of specimens	Body blotches	No. of specimens	Body blotches
Heterodon platyrhinos	7	22-29 (26.1)	14	21-28 (23.4)	17	20-25 (22.2)	16	19-27 (23.3)
Elaphe obsoleta	6	32-40 (35.5)	15	30-33 (31.3)	7	28-29 (28.5)	15	24-34 (30.2)
Lampropeltis calligaster			28	42-64 (47.6)	19	40-52 (46.3)	12	41-51 (45.5)
Sistrurus catenatus			15	30-40 (33.8)	7	26-35 (29.8)		
Heterodon nasicus	8	34-41 (37.7)	10	27-42 (33.8)				
Elaphe vulpina	22	35-52 (40.0)	37	32-42 (37.0)				
Pituophis catenifer	8	46-54 (50.1)	23	36-54 (48.5)				

in evaluating described entities in which blotch counts presumably aid in diagnosing the animals.

I have profited from discussions of this phenomenon with Drs. Sherman A. Minton, Hobart M. Smith, Herbert H. Ross, and Roger Conant. Dr. Robert C. Stebbins also has contributed suggestions of value to me. To all these men I am grateful.

ILLINOIS NATURAL HISTORY SURVEY, URBANA.

catenifer	(50.1)	(48.5)